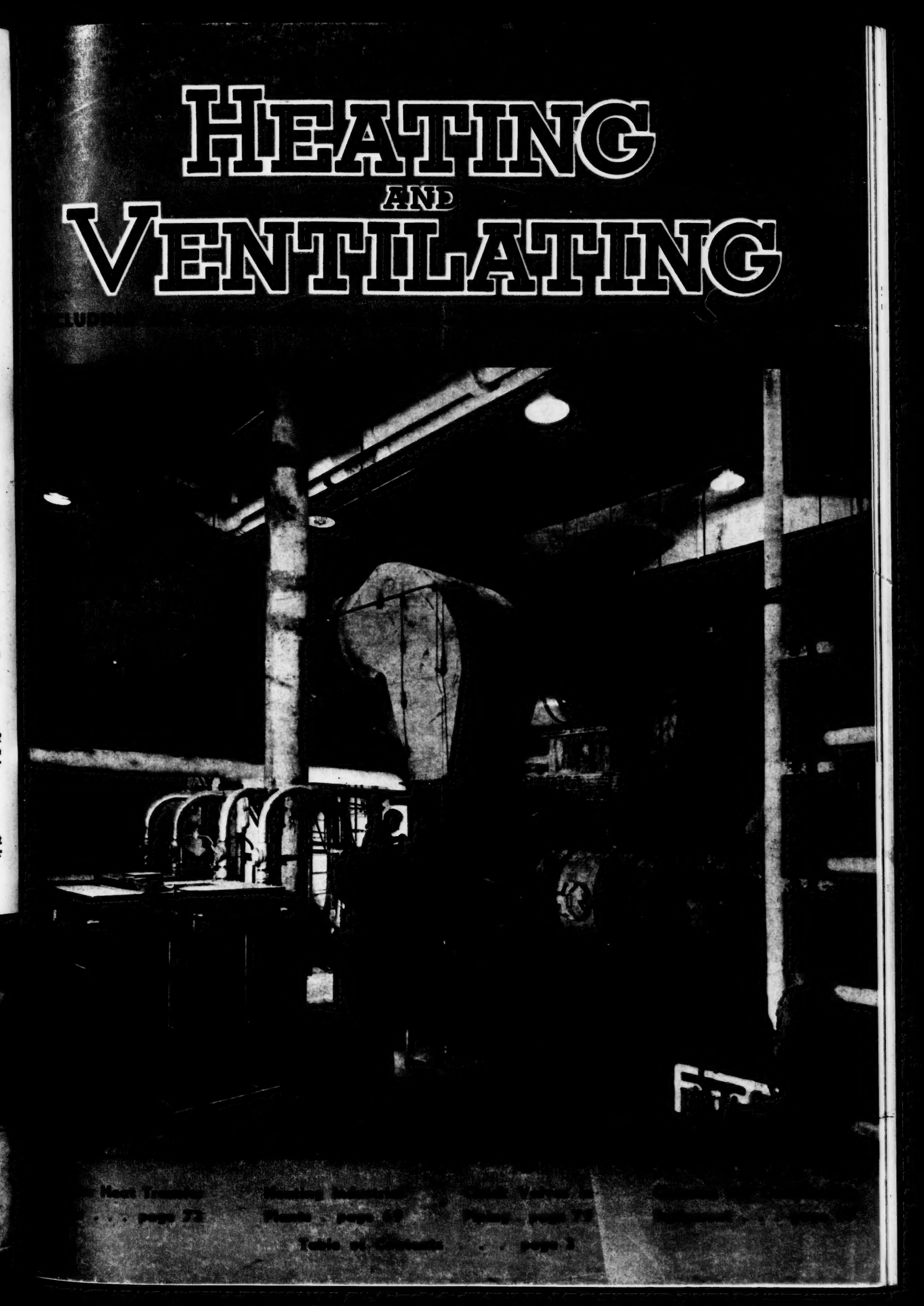
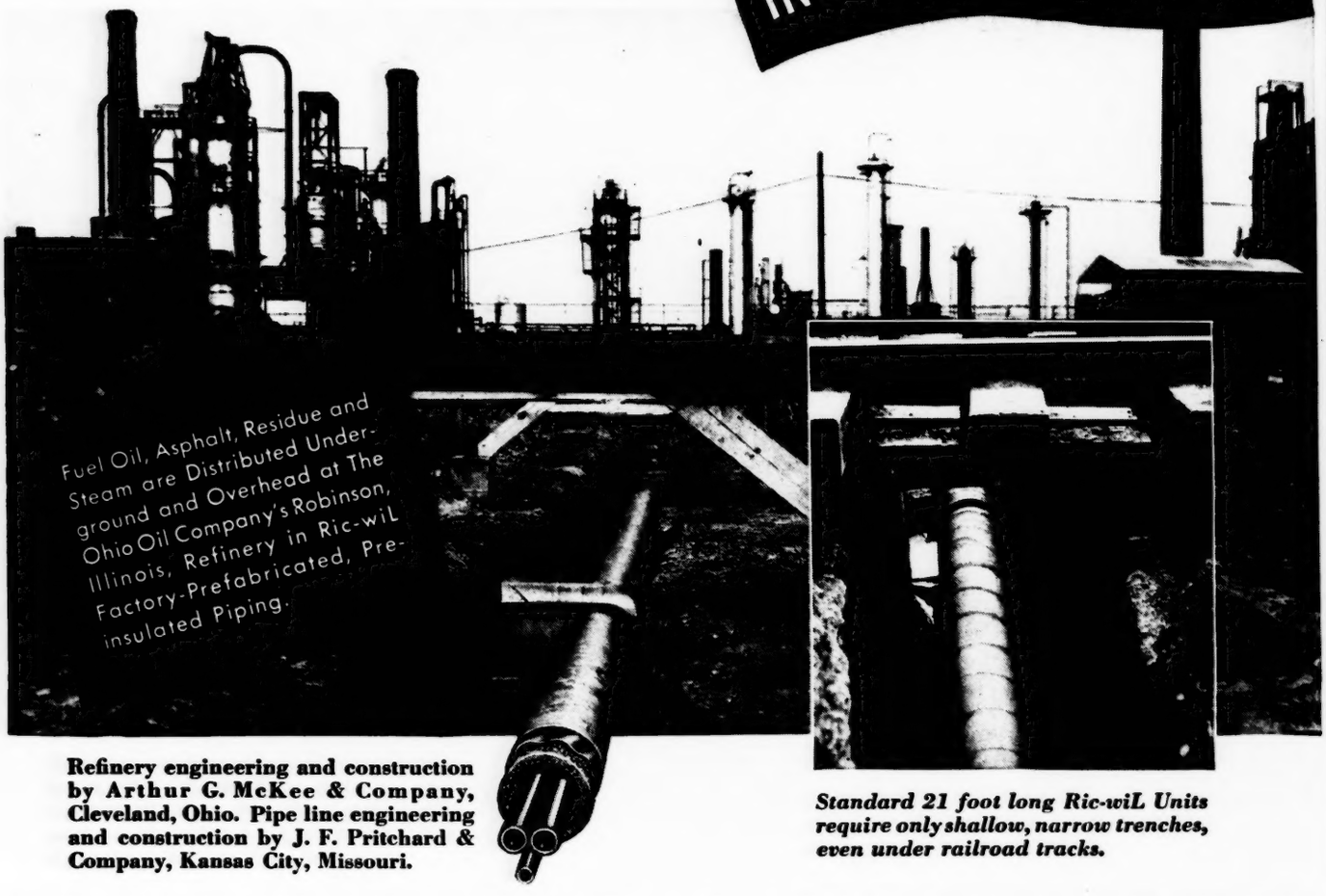
HEATING AND VENTILATING



Oil Refinery Meets Diversified Piping Needs with RIC-WIL

INSULATED PIPE UNITS



Fuel Oil, Asphalt, Residue and Steam are Distributed Underground and Overhead at The Ohio Oil Company's Robinson, Illinois, Refinery in Ric-wiL Factory-Prefabricated, Preinsulated Piping.

Refinery engineering and construction by Arthur G. McKee & Company, Cleveland, Ohio. Pipe line engineering and construction by J. F. Pritchard & Company, Kansas City, Missouri.

Standard 21 foot long Ric-wiL Units require only shallow, narrow trenches, even under railroad tracks.

● The adaptability of Ric-wiL Insulated Piping Systems to any type of piping requirement is ably demonstrated by this refinery installation. It consists of ten separate runs of prefabricated pipe units employing a wide variety of pipe sizes and pipe arrangements for distribution of steam and viscous fluids at various temperatures.

The temperatures required for the distribution of the various viscous fluids are efficiently maintained in Ric-wiL Uniline Insulated Pipe Units. In this type of construction, pipes carrying oil, asphalt, etc., are nested with a steam tracer inside an insulation liner which insulates them from the exterior but not from each other.

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Ric-wiL manufactures three basic types of Prefabricated Insulated Piping Systems—Hel-coR, Foilclad and Cast Iron Pipe Units. Pipe, insulation, and protective covering are factory-tailored to individual specifications to meet any condition or requirement for outside piping distribution. For descriptive literature, full information. write: The Ric-wiL Company, Department 1-D.

RIC-WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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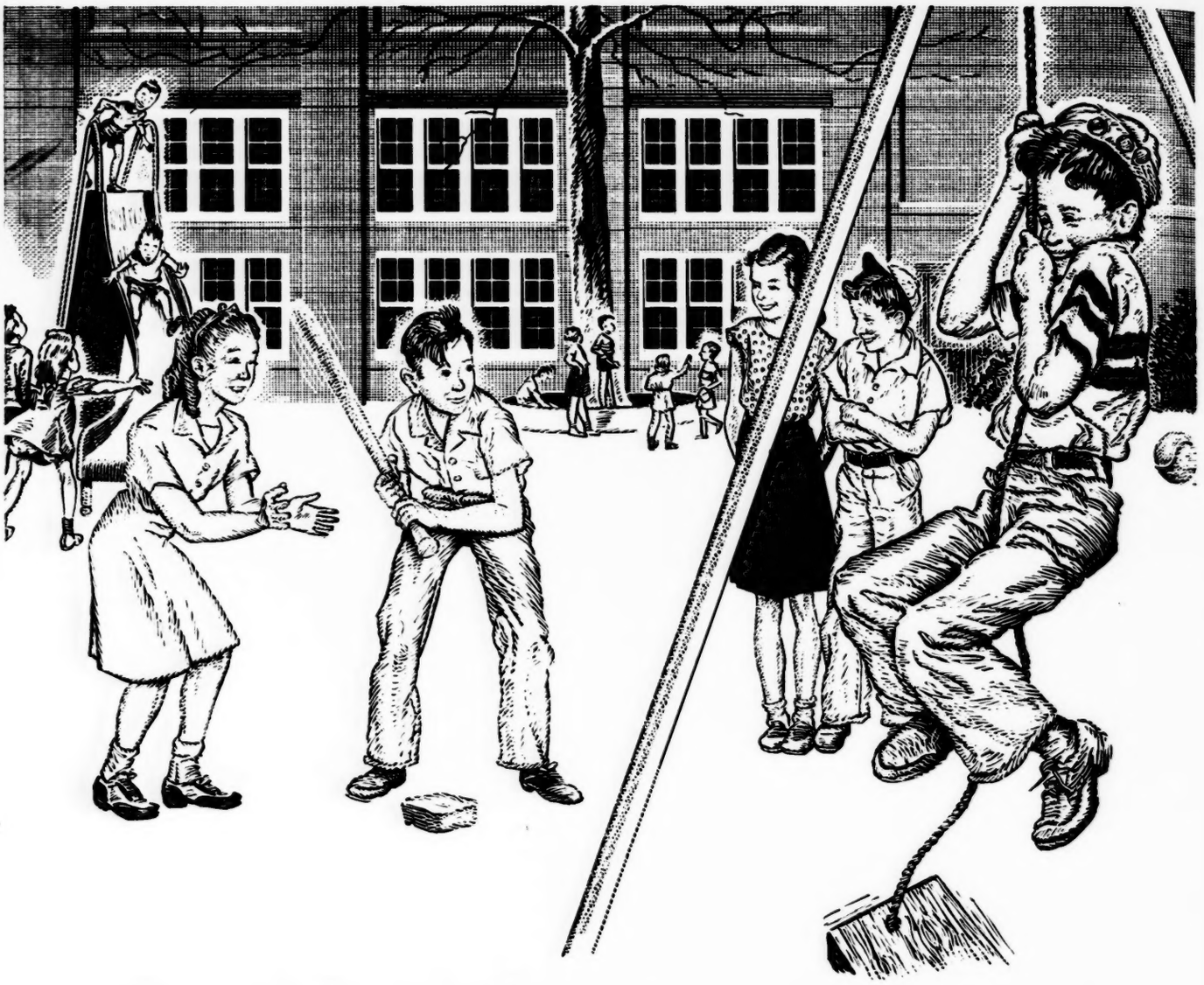
PUBLISHERS OF MACHINERY & MACHINERY'S HANDBOOK
The INDUSTRIAL PRESS

THIS MONTH'S COVER

Part of the main floor of the solvent recovery plant installed in the new rotogravure plant of the *Philadelphia Inquirer*. In the center are the blowers and starting motors and at the right, the tempering and filtering chamber.



Freedom begins at home

IN America we take Freedom for granted. It is hard for us to understand why anybody would willingly give up his freedom, to live under a rule that dictates every move of his life.

Yet we must face the sobering fact that right here at home there are plenty of people who are working to curtail, and eventually to abolish personal freedom, and substitute rigid central controls over our activities. Too often these misguided groups and individuals work harder at their self-appointed tasks than do we who think we prefer freedom.

We as business men, above all others, perhaps, have a responsibility in this matter which we can ignore only at the peril of our own survival.

The Youngstown Sheet and Tube Company

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MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

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Washington News

LORING F. OVERMAN

AMONG many February happenings in Washington of interest to the heating, ventilating, and air conditioning industries, four are particularly worthy of mention.

1. The new housing bill passed its first test with flying colors, forecasting speedy passage with little change.

2. Debate on extending the rent control law indicated early passage, with only certain procedural details open to change.

3. An industrywide research program for the construction industry was authorized, with government and private approaches channeled through a neutral agency.

4. Authority to extend voluntary control of steel was granted by Congress, as were existing export control requirements.

Housing Bill

The housing bill, a compromise between Administration and Republican proposals, was approved on February 24 by the Senate Banking committee. If passed by both Houses of Congress in its present form, it will be the largest in the nation's history—providing for top expenditures of 308 millions of dollars yearly for 40 years. It provides for:

The building of 810,000 Government-financed public housing units during the next six years;

A 1½ billion dollars slum clearance program in the form of loans and grants to states and municipalities;

A $262,500,000 rural housing program;

An extensive program of Government aid to housing research and a national housing census in 1950.

Republican members of the committee opposed the bill as a threat to private industry, and promised a floor fight when it comes up for consideration by the Senate. The promised opposition in the Senate will probably take one or all of three forms. Opponents are expected to propose amendments prohibiting racial segregation in publicly financed housing developments; prohibiting employees of Federal, State or local governments from occupying public housing, and limiting occupancy to persons making less than $1200 a year, except in cities of 100,000 population, where incomes of $1500 would qualify.

Rent Control Outlook

Prolonged debate in the Senate on any of these proposals could stymie passage of the bill, and Senate leaders are pondering whether to let the housing bill reach the discussion stage before changing its rules to curb filibusters.

There seems little likelihood that rent controls will be permitted to expire on March 31. The question is how long they will be continued, and in what form. The question of whether to put controls back on housing that was decontrolled by the present law is also involved, as well as the subject of how much authority to give federal rent control officials.

While it might seem that the fate of the rent control law is of no direct concern to those who plan and engineer heating, ventilating and air conditioning facilities, those who oppose extension of the law take another view. They contend that freezing of rents at a level far below other living costs is not only responsible for the existing shortage, but that it is blocking both new construction and repairs. Until the law is dead, they contend, the capital needed to finance new construction will remain in hiding.

Its responsibility for the present shortage, they explain, lies in the fact that it encourages occupancy of millions of family units by single persons. If controls were lifted, automatically lifting rents, realtors contend that many of these one-person families would seek single rooms or other accommodations.

The National Association of Real Estate Boards points out that in April, 1947, 3,714,000 individuals were classified by the Census Bureau as one-person families, and that 2,896,000 of that number lived alone. If 1,000,000 of these could be induced to seek quarters in keeping with their status as individuals, more family units would be vacated than were built during the entire year of 1948. This quick availability of family units would solve the immediate shortage of this type of accommodation, real estate men say. At the same time, they contend, by lessening the pressure of demand, rentals would advance only slightly.

Not Frozen

Countering the assumption that rents would not skyrocket if decontrolled, the Administration points out that rents are not frozen even though they can be controlled. Increases are obtainable by landlords having legitimate cases. From the beginning of rent control through the end of 1948, a total of 2,718,163 landlord petitions for rent increases were processed. Of this number, 63.2%, or 1,717,429 were granted in whole or in part. The percentage of increases granted has been rising steadily in recent months. In January, 1947, cases approved totalled 64.2%. In December, 1948, it was 73.3%. During the last five months of 1948, increases averaging 19.9% were granted on 245,348 houses and apartments.

A survey by the Housing Expediter of 44,626 units decontrolled under the present law showed rent increases of 55%, from an average of $65.98 to an average of $102.29. It would not be surprising if the latter example is the one members of Congress will remember when faced with the decision of whether to continue rent controls or to let them die.

Neutral Building Research?

Whether the answer to the present housing impasse lies in the new compromise housing bill, or in some

In the southwest's greatest hotel

BYERS WROUGHT IRON PIPE *in eleven services*

The Texas reputation for doing everything in a big way is upheld by the new $20,000,000 "McCarthy Center" project, of which the Shamrock Hotel opening March 17 is a part. The fact that the job is being done in the *best* way is suggested by the specifications, which include wrought iron in eleven different services. Drainage lines, downspouts, fire lines, condenser water lines, condensate returns, exhaust lines, hot and cold water lines over 3 inches, chilled water lines over 3 inches, air lines, and swimming pool piping, are Byers Wrought Iron pipe, in sizes from 3/8-inch to 20-inch.

Every one of these services carries a corrosive threat—and every one represents a time-tried wrought iron application. Surveys of old buildings, made in a number of areas, have shown wrought iron pipe still serving in heating and plumbing lines after periods of 40 to 50 years. The same surveys revealed many cases where pipe made of low-first-cost materials in newer buildings had failed in a fraction of that time.

Wrought iron's unusual serviceability comes from its unusual character. Tiny threads of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. They also anchor the initial protective film, which shields the underlying metal.

Our bulletin, "Wrought Iron for Piping Systems" gives a digest of the experience of designers with wrought iron in building services. Ask for a complimentary copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N. Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

revision of the rent control law, the fact remains that all are agreed that present housing costs too much.

It was to seek some nationally satisfactory answer to this problem of quality building at reasonable price that a most important meeting was held in Washington on February 17. At this meeting a new alphabetical agency, BRAB (Building Research Advisory Board), was formed to conduct a neutral research project covering all phases of residential, commercial, industrial, and institutional building.

BRAB is not a government agency, although government is making plans to channel much or all of its building industry research through that body. Nor is BRAB a branch of private industry, although it will derive much of its resources from private industry, and will use industry's research facilities. Instead, the new Building Research Advisory Board is a subdivision of the National Research Council, the administrative arm of the National Academy of Sciences.

Authorized by a charter granted by Congress in 1863 to investigate, on request, any subject of science or technology within its field, the National Academy of Sciences has been considered by both government and industry as completely neutral and unbiased in all its undertakings. Its executive arm, the National Research Council, established by Presidential executive order, has retained the same characteristics, and as a board of that council, BRAB should add to building research a degree of neutrality hitherto unattainable.

The chairmanship of the Board has been accepted by Dr. Frank B. Jewett, recently president of the National Academy of Sciences, formerly president of the Bell Telephone Laboratories, Inc., and during World War II a member of the National Defense Research Committee of the Office of Scientific Research and Development. The initial membership of BRAB is made up of 23 members appointed by the National Research Council because of their interests or accomplishments in scientific and technologic research and development in building construction or in scientific and engineering fields associated with building construction. Members have been appointed also with regard to geographical distribution and to their representation of government, industry, labor, university, or other non-profit organizations.

What BRAB Adds

The major contribution which the neutral BRAB is expected to make to building research is the one vital ingredient now lacking—correlation of effort. Industry conducts countless research projects dealing with specific phases of building. Government, through the new housing bill, is about to authorize additional research. But for building construction as a whole, there has been no disinterested, unbiased, centralized agency to keep in touch with all that is being done. This clearing house function is to be the first objective of the Building Research Advisory Council.

Its present formal objectives, as announced at its initial meeting, are:

1. To list, review, and correlate the results of completed research.
2. To list, review, and correlate current research activities.
3. To disseminate information so obtained.
4. To sponsor forum discussion of research aims and results.
5. To coordinate research effort and actively sponsor elimination of needless research.
6. To foster research in relatively undeveloped areas.
7. Generally to further the application of scientific methods for the improvement of building construction practices.

Finance

The foregoing initial program of BRAB is to be financed through subscriptions from the industry, at the recommendation of the Construction Industry Advisory Council of the Chamber of Commerce of the United States. This Council, after three years of study in the construction field, found that the efforts of some neutral body would be required to give full force to research findings. Labor's acceptance of the logic of such a move is indicated by the appointment of Richard J. Gray, president of the Building and Construction Trades Department of the American Federation of Labor, to membership on the BRAB board. Similarly, government's acceptance is implied by the board membership of Leonard G. Haeger, Director of the Division of Standardized Building Codes and Materials, Housing and Home Financing Adminstration.

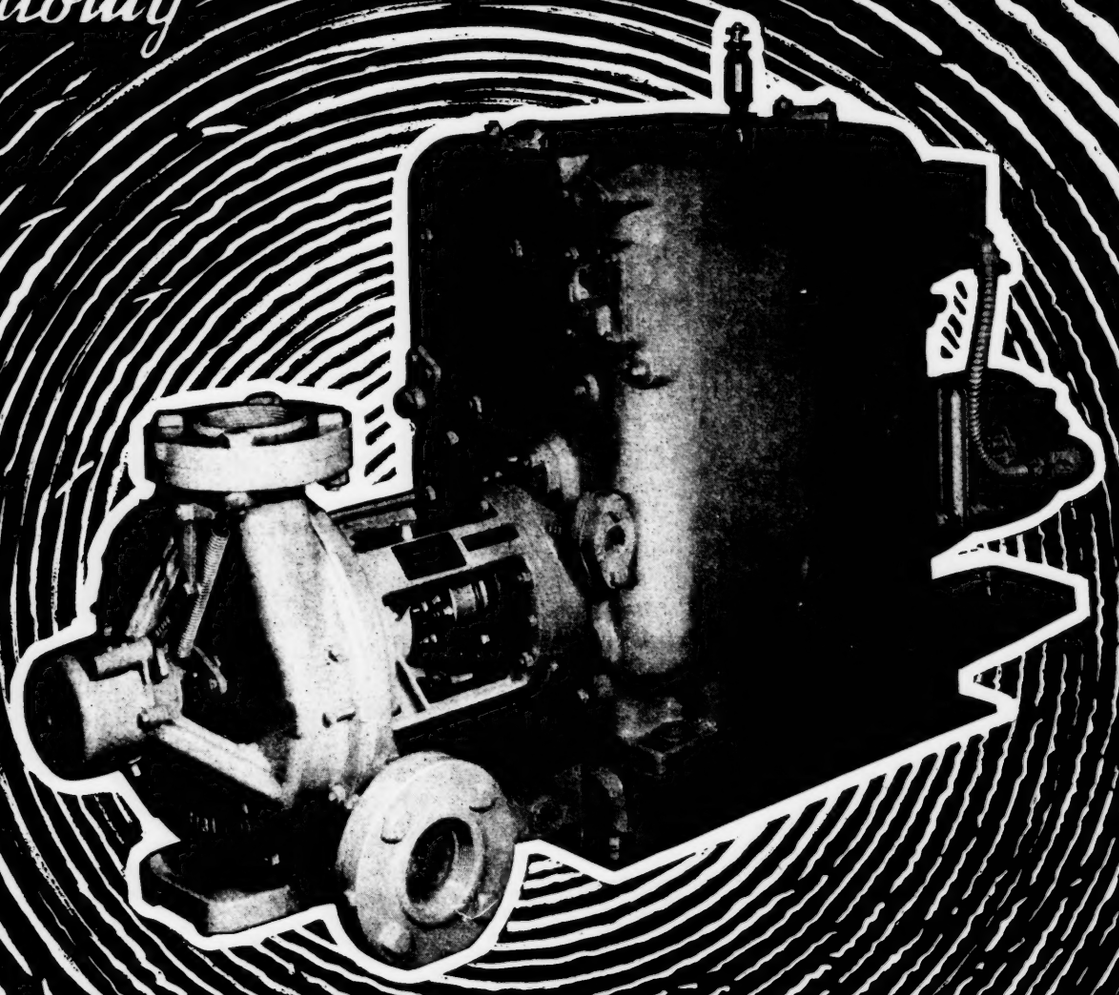
Industry's share in financing BRAB has been estimated at $100,000 per year. Government is permitted to reimburse the National Academy of Sciences only for out of pocket expenses on any projects on behalf of government. The Housing and Home Financing Agency has indicated, however, that if it receives funds for research under the new housing bill, that it will employ "existing facilities" without setting up expensive new research projects.

BRAB Voice

Formation of the Building Research Advisory Board under sponsorship of the National Academy of Sciences implies no compulsion for the building industry to change any current practices which may be found, through research studies, to be uneconomical. The function of BRAB will be merely to publicize the findings of factual studies in the building field, and to let industry and the public determine which course it prefers to follow. In other fields, where the findings of the National Academy of Sciences are accepted as the last word on the subjects involved, acceptance of that viewpoint has been a natural result. It is expected, therefore, that BRAB conclusions, as applied to building, will receive similar acceptance in the construction industries.

Thus, while BRAB will not specifically re-write building codes or issue other hard and fast specifications, the results of BRAB activity would be of material assistance to groups responsible for the promulgation of such codes, specifications and standards.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Solvent Recovery Cuts Roto Ink Costs

W. B. LEIGHTON
Carbide and Carbon Chemicals Corp., New York, N. Y.

Description of the system installed in the new Philadelphia Inquirer rotogravure plant to recover 2,000 lb per hr solvents now released in drying the inks. With allowance for future production increase and press expansion this will be 4,400 lb per hr. Besides presenting the solvent and recovery cycle, article covers control and safety features.

SIXTY-ONE press units, including fifty regular production presses, are now in operation in the new rotogravure plant of the Philadelphia Inquirer, Philadelphia, Pa. At some future date this capacity may be increased to 140 presses. But before actual construction was started, the design engineers were faced by two important problems.

(1) How to recover the highly volatile solvents in the roto inks in order to cut printing ink costs.

(2) How to be a good neighbor to the others in the crowded downtown area by avoiding situations that could develop from the discharge of large quantities of solvent vapors into the air.

Recovery of Solvents Proposed

The answer to both problems was the installation of a solvent collection and recovery system employing a special type of vapor adsorbent carbon. With all requirements in mind, engineers of the Special Products Division, Carbide and Carbon Chemicals Corp., proposed a two-unit solvent recovery plant.

One-half of the system installed is designed for recovery of the high-speed solvent used in the inks applied to newspaper rotogravure stock. This solvent, consisting of esters and hydrocarbons, is selected because of its rapid evaporation rate. The inks dry quickly enough to keep pace with the high-speed presses through which the paper passes at a rate of

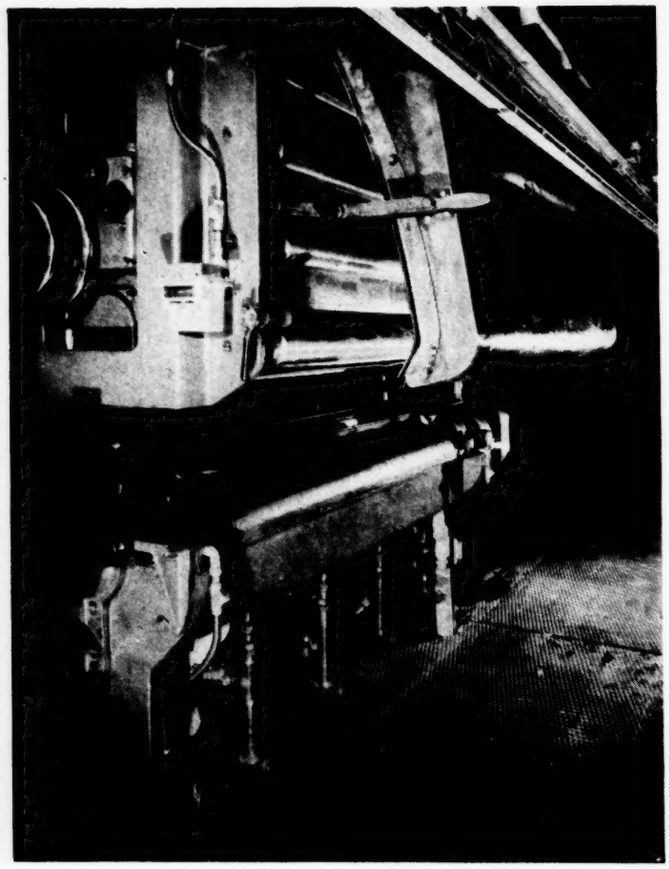


Fig. 1. Tight fitting hoods are placed over each press unit. As paper web passes through, warm air volatilizes the solvent which is picked up by the hood.

1,000 fpm. The other half of the system is designed for recovery of the low-speed solvent in the inks for printing cover stock and coated paper used in magazines. The presses used for this printing are run at somewhat lower speed. Paper will move through the cover press at a rate of 500 fpm or less, while magazine stock paper will be fed at rates only slightly below that of newspaper stock paper. In the event that high-speed inks are used with magazine stock paper, both halves of the recovery system will handle a common solvent.

The solvent collection system is expected to collect a minimum of 80% of all solvent used in the inks, and the recovery system is expected to deliver substantially all of this solvent for re-use. Net savings to be realized in 3 to 4 years from solvent recovered from existing press operation only is expected to pay for the following: The complete recovery installation, including vapor-collection, activated carbon adsorption, distillation, solvent storage and handling facilities; and the building which provides for existing and future equipment requirements.

Solvent Vapor Collection

Since efficient collection of solvents from the press units was a prerequisite to high over-all solvent recovery, the presses were designed with this as an objective. Deeply recessed ink fountains with well enclosed printing cylinders not only assist in efficient solvent collection but prevent undesirable drying of ink on the printing cylinders.

Each press unit is equipped with a tight fitting hood, Fig. 1, under which the paper web passes after it leaves the printing cylinder. Heated air is passed through this hood, thus vaporizing the solvents and drying the ink following each impression. Vapor-laden air from each hood is exhausted through a duct which delivers the air to the top floor of the rotogravure building. There, through the proper system of exhaust fans and duct headers, it can be passed through either half of the solvent recovery plant. In case of emergency, these same fans and duct systems can exhaust the vapor-laden air directly to the atmosphere.

This extensive collection system provides for picking up the solvent air mixture at any one of the 61 press units and feeding it into either half of the dual recovery system.

Special floor ducts were installed to pick up solvent vapors during periods when press units are opened for cylinder changes, washing of cylinders, or cleaning of ink fountains. Careful consideration was given to the efficient collection of solvent vapors at all points where these vapors might conceivably escape. Balance of fresh make-up air supply to the pressroom and withdrawal of vapor-laden air from the pressroom is such as to cause a slight vacuum in the pressroom. This negative pressure keeps any stray solvent vapors confined to the pressroom area. Consequently, any such vapors ultimately pass into the collection system.

Working conditions at the rotogravure presses are improved as the result of well enclosed printing cylinders and press drying hoods designed for maximum solvent pick-up. The working areas are freed of solvent vapors.

Solvent Cycle and the Recovery Plant

Incoming inks for use in the roto presses are supplied as relatively thick pastes with minimum allowable solvent content. Sufficient additional solvent is added to raise the solvent concentration to approximately 75% by weight before the inks can be used. Present solvents are ester-hydrocarbon mixtures.

In order to provide adequate drying, while at the same time maintaining exhaust air requirements within an economical range for solvent recovery, part of the exhaust air is recycled. Average temperature maintained in the hoods is about 125F.

Vapor-laden air delivered to the recovery system by the press exhaust fans is picked up and passed through this system by four motor-driven blowers, two blowers in each recovery unit. These blowers draw the air through removable glass fiber filter units. Air is then passed through finned-tube, air cooling and heating units for proper tempering prior to passage through the beds of activated carbon contained in special adsorber vessels. Vapor-laden air enters the top of the adsorbers at one end while the exhaust air, stripped of solvent, issues from the other end.

Low pressure steam is used to remove the adsorbed solvent from the carbon and to carry the solvent vapor to equipment where both steam and solvent are con-

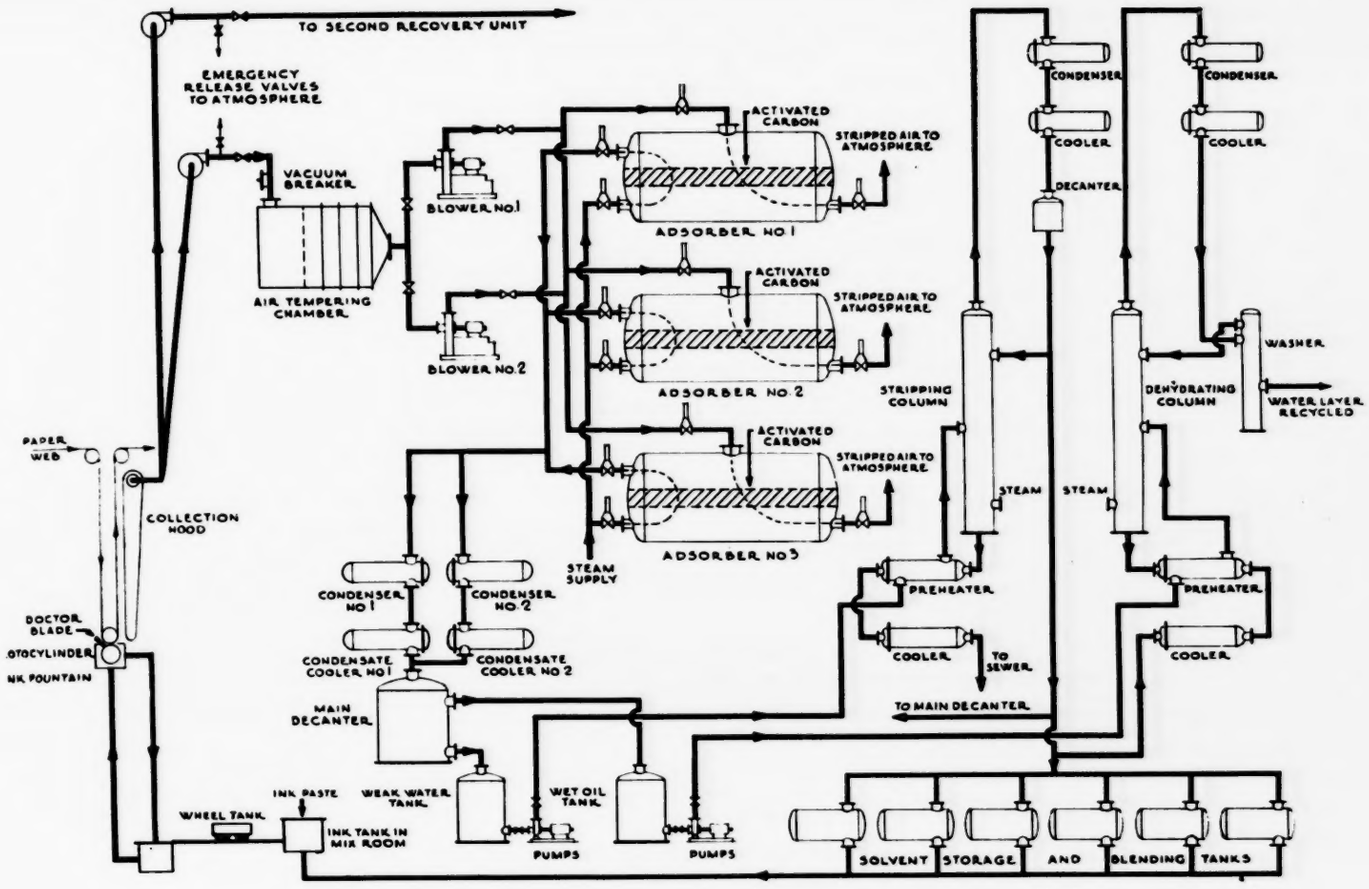


Fig. 2. Flow diagram of the recovery plant and solvent cycle.

densed and where the solvent is processed for re-use. The solvent-processing part of the system consists of condensers, coolers, decanters, washers, heat exchangers and distillation columns, and inter-connecting piping. All of this equipment is fabricated from Type 347 chromium-nickel stainless steel for maximum service life and freedom from contamination. Stainless steel piping was fabricated by means of inert gas welding.

The steam and solvent mixture from the adsorbers of the two recovery units passes to condensers and coolers on a mezzanine floor above the main recovery plant floor where the mixtures are condensed and cooled to flow by gravity through a system of piping to a sub-basement level. Here they enter stainless steel-lined, continuous decanters to separate the aqueous and hydrocarbon layers.

The upper layers from the decanters may contain hydrocarbons ("petroleum fractions" etc.) some ethyl acetate, isopropyl acetate, and butyl acetate. If present in the inks, smaller amounts of ethanol and acetone may also appear here. These layers flow by gravity into "wet oil" surge tanks and are then pumped through preheaters to dehydrating columns which are designed to reduce the water content of the solvent to a minimum. Solvent from the base sections of these columns is cooled and sent to dried solvent storage. Solvent-containing water, removed as distillate from the dehydrating columns, is then recycled back to the main decanters of the solvent recovery plant.

From the main decanters, too, the lower layers of so-called weak-water flow by gravity into weak-water surge tanks. This liquid contains the major portion of the water soluble components of the ink solvents. These may include esters, ethanol, and possibly acetone. The water layers are pumped through preheaters to distillation columns where substantially all of the solvent is stripped out as distillate. Water waste from the stripping columns is cooled, mixed with cool waste water from plating and photographic room processes, and discharged to the sewer.

The destination of solvent distillate from the stripping columns depends upon its composition. It may either be transferred directly to storage or returned to the main decanters for further separation and purification.

Solvent from the storage area is properly blended and re-used by mixing with incoming inks in a special ink mixing room. The final mixtures are moved to the press fountains in closed wagons.

Ink Formulations are Flexible

It was considered possible that, at some future date, the rotogravure technical staff might wish to vary the ink solvents, using other ester, hydrocarbon, alcohol, or ketone solvents. This would require extreme versatility in the recovery systems.

The dual recovery system permits handling two extremes in evaporation rates of solvents. Thus, high-speed and low-speed solvents can be handled separately. The essential difference between

Building was designed by Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

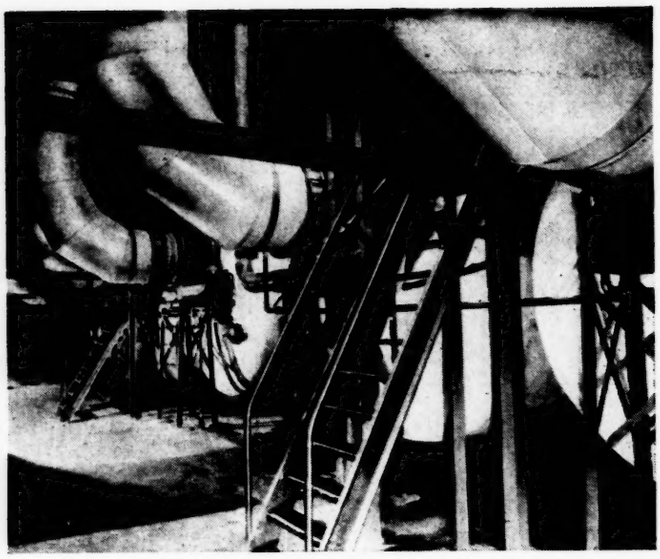


Fig. 3. Exhaust air, after being stripped of solvent, passes through these stacks at the rear of adsorbers.

these two speeds is usually obtained through variation of the hydrocarbon fraction.

Best prediction at the outset was that the quantity of solvents for high- and low-speed inks used would be approximately equal. This is the ideal condition for the present recovery system with its two complete units. In the event of unequal consumption, the solvent handled by one 3-adsorber recovery unit may consist of a mixture of two different speed solvents. If the proportion of these solvents is such as to favor either high- or low-speed solvent, the mixture can be prepared for re-use by addition of proper solvent.

If the balance between the two solvents is such that the solvent mixture recovered is unfavorable for reformulation by solvent addition, space is available to add batch distillation equipment to make definite boiling range separations. Such equipment may never be justified because it would only be for use in extreme cases at solvent change-over times, or because of an unusual demand for a special type of printing.

The ability to remove a variety of solvents from the weak-water and to separate water from the hydrocarbon solvents by employing a system of both stripping and dehydrating columns, permits wide latitude in the range of solvents that can be separated. Provisions have, in fact, been made in the tank field for a number of different solvent cuts.

Solvent storage field is all underground. Storage tanks are connected by 1½ and 2 in. lines to an ingenious manifold, control and pumping system in an underground room adjacent to the tank farm. Through this system, solvents from high-speed and low-speed inks, new solvents, and solvents being blended for reuse can be led into or drawn out of the proper tanks. Maximum flexibility was stressed at every point with respect to possible future ink formulations requiring varying solvents as thinners.

Savings Through Solvent Conservation

While operating figures are being kept, the plant has not been in operation long enough to yield costs or efficiencies. However, experience in other plants indicates that over-all solvent recovery should be 80% or better. This will, of course, reduce costs of new solvent used in the printing paste to a very small fraction of what it might have been otherwise.

Due to the high adsorption efficiency of the special vapor adsorbent carbon used, and the special design of the recovery equipment, there is a negligible loss of solvent picked up by the collection system and delivered to the recovery plant. Here, then, is the answer to the first problem—conservation of valuable solvents used in the roto printing process.

Disposal of Solvent-Stripped Air

From each adsorber, the vapor-free exhaust air is carried by ductwork to a large plenum chamber. This chamber is actually a room constructed as part of the rotogravure building and is located along an outside building wall. The chamber is equipped with louver-type outlets which are an integral part of the building wall. These outlets handle the entire volume of exhaust air from the recovery plant.

The plenum chamber serves to combine blow-off steam and high-moisture content air from freshly steamed adsorbers with low-moisture content air from adsorbers well along in the adsorption cycle. The resultant mixed exhaust air stream discharges through the building wall louvers with a minimum fogging effect. Entrained moisture is practically completely removed within the chamber.

Air exhausted to the atmosphere is substantially solvent-free and odorless. This satisfies the second condition imposed upon the recovery system when the new rotogravure printing plant was contemplated in downtown Philadelphia.

Coordination of Operation

Signal lights in the solvent recovery plant control room indicate which of the two solvents, high- or low-speed, are being used on each press. These lights

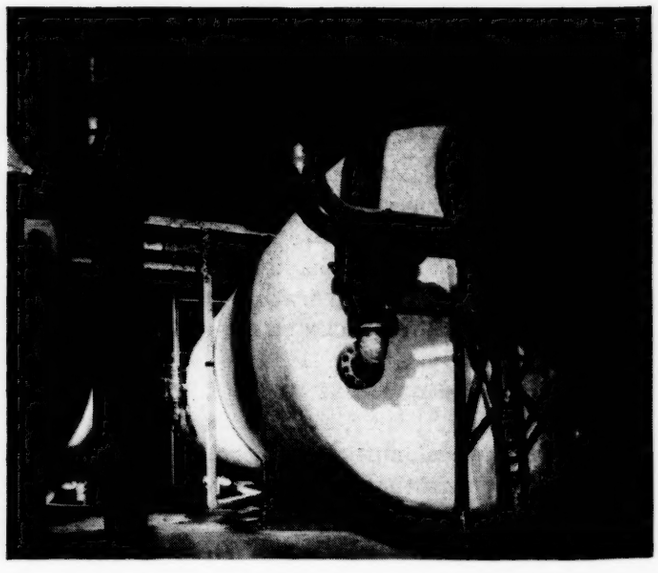


Fig. 4. Close-up of the adsorbers in the solvent recovery plant. Six such units are installed.

assist the recovery plant operator in determining whether the various presses are connected to the collection headers for discharge of vapor-laden air to the proper recovery unit. This remote signal light and damper control system parallels a similar system installed at the individual presses. Each time a press is placed in operation on a new production run, it is only necessary for the press foreman or recovery plant operator to make sure that the damper in the collection duct from that press is set to pass vapor-laden air to the proper recovery unit. In every other respect, press operations are entirely independent of recovery plant operations.

The total volume of air being handled by the blowers in either recovery unit is automatically controlled to maintain a definite suction of approximately one inch of water at the recovery unit air inlet. This suction is held constant regardless of the number of press units that may be operating. Thus the air discharge from the presses to the recovery plant is identical to or slightly better than if the presses were to exhaust directly to atmosphere. If the suction at either recovery unit inlet is reduced below a predetermined value, a pneumatic circuit positions relief dampers automatically so that the press fans will discharge vapor-laden air directly to the atmosphere.

The total air-handling capacity of the solvent recovery plant is sufficiently great to insure adequate ventilation of all the press units when all are in operation. This large air volume capacity permits extreme latitude in printing operations without risking hazardous concentrations of solvent in the exhaust air from press units. Solvent concentration is not expected to exceed one-quarter of the lower explosive limit.

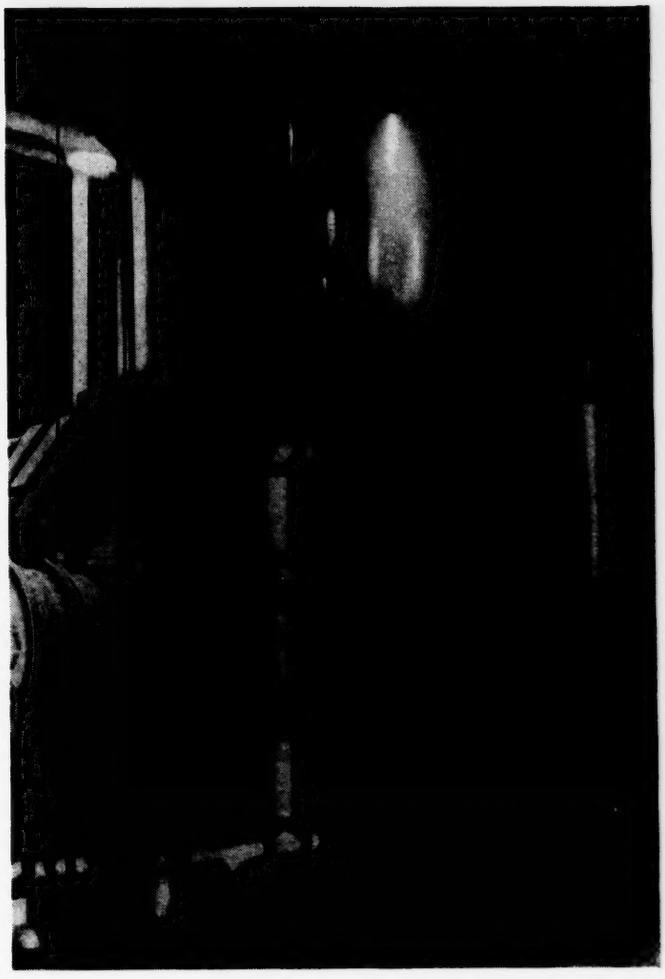


Fig. 5. Solvent-air mixture, picked up from presses, is passed through this filtering and tempering chamber before it enters adsorbers.

Automatic Controls

Operation of the recovery plant is as completely automatic as possible with the exception of starting up and shutting down the distillation equipment. The necessary instruments and control interlocks are located in one central control room on the top floor of the rotogravure building. From this control room area, the recovery plant operator is able to observe and control operations in the entire recovery plant system.

The operating cycle of each 3-adsorber unit is set so that most of the time two adsorbers are in parallel service, receiving vapor-laden air, while the third is being steamed. The vapor-laden air streams are passed in succession to each adsorber until it is fully charged with solvent. While there are always two adsorbers receiving vapor-laden air, the service periods of each are so adjusted that when one is fully charged the other is only half charged.

To effect removal of the adsorbed solvent, steam is passed into the charged adsorbers. Following this, the freshly steamed adsorber is opened to the vapor-laden air stream just long enough to reduce its temperature and to partially dry the carbon bed. It may then be placed in service again.

The cycle of operations in each recovery unit is controlled automatically. The total adsorption time is automatically increased or decreased in accordance with the air flow which varies nearly proportionally with solvent load. The steaming rate and steaming time are also controlled automatically. Although the two recovery units have been designed for independent operation, the operating cycles are so interlocked that no two adsorbers can start steaming at the same time. This prevents excessive instantaneous steam demands.

Safety Features Stressed

Since the solvents used in the rotogravure inks are highly flammable, it was necessary to give careful consideration to the handling of these solvents at all points in the solvent cycle.

The first safety step was to make sure of adequate ventilation of the press units at all times so that the concentration of solvents in the exhaust air could be kept within a safe operating limit. To make certain that these concentrations remain within safe limits at all times, continuous combustible gas analyzer units are utilized to analyze continuously and to record the concentration of solvent vapors in the various press exhaust ducts.

These concentrations, which are recorded as percentages of the lower explosive limit, are not expected

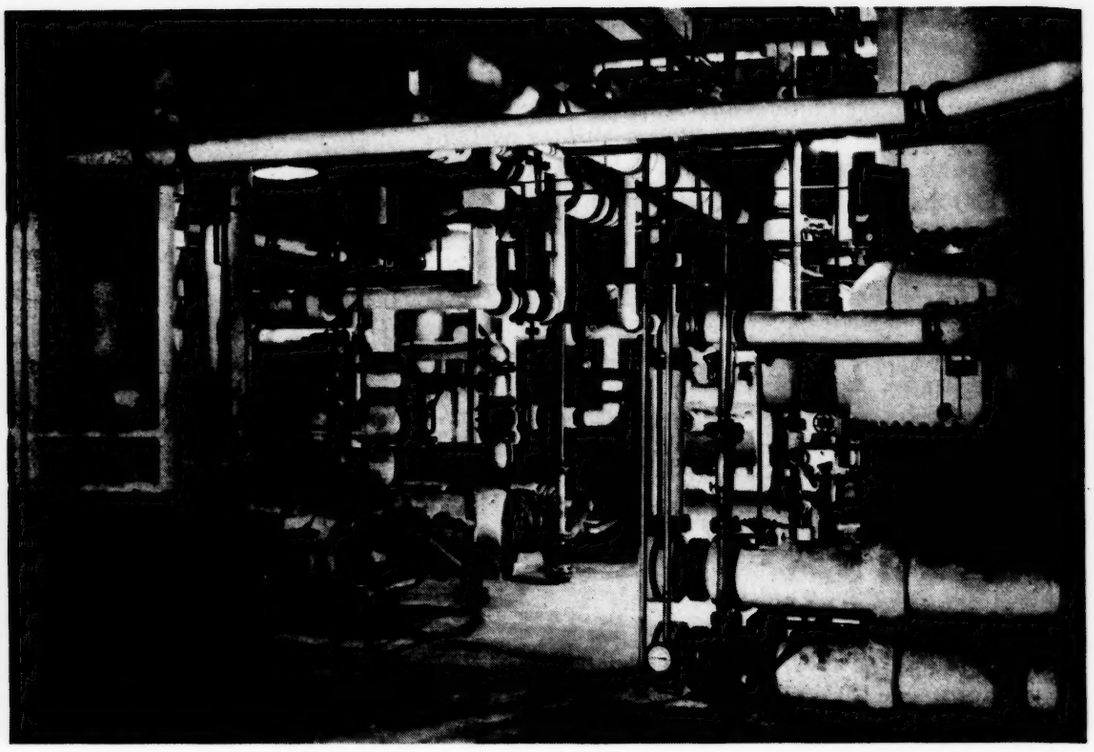


Fig. 6. View of bottom of distillation columns which extend to the top of building, three stories above.

to exceed one-quarter of the lower explosive limit under normal operating conditions. If for any reason they are exceeded, warning alarms are sounded. In addition to analyzing and recording continuously the concentration of solvent vapors in the press exhaust ducts, gas analyzers are also used to record continuously the solvent concentrations that are present in the main vapor-laden air ducts leading to the two recovery units.

The recovery plant distillation equipment is located in a special fireproof tower section of the building, protected by a carbon dioxide system and provided with forced draft ventilation. This ventilation is, of course, cut off in the event that a fire initiates the carbon dioxide system. Special control interlocks insure that further discharge of solvent to the distillation section is cut off in the event of fire. Equipment in the distillation section is arranged and designed for a minimum solvent hold up at any time.

The decanter room in the sub-basement section of the rotogravure building is also equipped with carbon dioxide flooding nozzles and is well ventilated. All piping within the building walls or floors, designed for carrying solvent from one part of the process to another, is encased with outer steel piping and is embedded in concrete so as to fully comply with fire department regulations and local ordinances covering such installations.

Air in the decanter room and in the ink mixing room is continuously analyzed for solvent concentration. Instruments maintain a 24-hour record of these concentration readings. In the event that solvent is detected, an alarm is sounded.

The handling of large air volumes from the press units, adequate ventilation of all areas in which solvents are handled or stored, and continuous analyzing and recording of solvent concentrations in the various solvent areas, insure safe operation of this large recovery installation.

Future Expansion

The present recovery plant is designed for 80 press units. As additional presses are added to the existing 61, solvent recovery will increase and the over-all plant amortization period will be decreased. Further capital expenditure for press and recovery equipment can be paid for in even less time, since the initial heavy investment in future building space requirements, ink and solvent handling and storage facilities will have been largely paid for by solvent recovery from existing operations.

The area provided for solvent recovery equipment is double the size now needed, to allow for future expansion. Steam and water supply headers have twice the carrying capacity needed for the equipment now in operation. Each of the recovery units now installed contains sufficient carbon to permit handling solvent at the average expected rate of 3,200 lb per hr with a total of 80 press units in operation. However, provision has also been made in the size of each adsorber vessel to permit adding sufficient carbon to handle solvent at the maximum expected rate of 4,400 lb per hr.

Credits

Vapor collecting and drying hoods on each press, and the ducts and duct header system for delivery of vapor-laden air to recovery plant—supplied by B. Offen & Co., Chicago.

Recovery plant equipment and necessary inter-connecting piping; also stainless steel piping for transfer of recovered solvent to the presses—installed by W. K. Mitchell Co., Philadelphia. Company also fabricated pipe.

Storage tanks, interconnecting piping, pump room, tank car and tank wagon loading and unloading facilities—designed by Eggley-Furlow Engineers, Philadelphia, in cooperation with the Carbide and Carbon Chemicals Corp.

Cleaning Air Conditioning Equipment

E. WITTSCHIEBE
Oakite Products, Inc.

AIR conditioning equipment is vulnerable to accumulations of various types of deposits of foreign materials which impair performance, and a very necessary part of maintenance is to keep the system in a clean condition. Slime and hard water scale are probably the two most commonly found deposits, and where present on surfaces must be removed if the equipment is to work efficiently.

Slime is a formation that is caused by the presence of algae or bacteria in the air or water supply. Slime retards heat transfer and causes objectionable odors. Hard water scale is the result of the deposition of mineral salts contained in the water supply, and also seriously impairs the proper transfer of heat. Generally, the building up of both these deposits can be controlled, as will be shown, but if they have already accumulated they must be removed so that the entire system will function as it should.

Removing Slime

The evaporative condenser might be considered as a focal point for a discussion of cleaning procedures. A device for condensing hot refrigerant gases, the evaporative condenser uses both water and air as condensing media and it is subject to the twin evils of slime and scale. Both hard water scale and slime may be found on coils, fins, in spray nozzles or headers, on eliminator plates, and in other spots. In some cases slime may become so thick that it will block the passage of air through the coils.

Cleaning these coils and other surfaces is a fairly simple matter and, with the right materials and methods, the units can be quickly restored to proper working order. Slime on coils or in the sump tank can be removed with specially compounded alkaline cleaning materials. The cleaning solution is made up in the sump tank, or in a suitable container, and is circulated until the system is clean. At the completion of the job, the dirty solution is drained and the sump tank refilled with fresh water. To avoid building up pressure of the refrigerant in the coils, the temperature of the cleaning solution should not exceed 120F, unless it is preferred to pump out the refrigerant before the cleaning begins.

If the slime accumulations are long standing, it may be necessary to use pressure methods to remove them. In this event the alkaline cleaning solution should be applied by means of mechanical cleaning equipment utilizing air pressure or steam. Such a piece of equipment is very handy to work with and makes it possible to reach inaccessible areas which may be particularly fouled up. Rinsing can also be accomplished with the same unit.

Some types of evaporative condensers are so designed that coil assemblies may be removed with very little difficulty. If so, it may be preferred to remove them and do the cleaning work in a tank or vessel containing the proper alkaline cleaning solution. This solution should be made up at the proper strength and should be heated to a temperature of 160 to 180F. A fresh water rinse should follow.

Scale knocked off the coils of an evaporative condenser.

Descaling the Unit

Hard water scale may be removed by circulating through the spray nozzles a dilute solution of an inhibited, acid type material. Titration should be performed regularly and the progress of the descaling closely observed. As soon as the scale removal action is completed, the acidic solution should be drained and neutralization with the same material used for slime removal should follow. A fresh water rinse completes the job before the sump is refilled once more.

After the cleaning and descaling have been accomplished, the formation of scale and slime in the condenser can be minimized by the use of a product especially designed for water treatment work. Such a material must be completely soluble in water and must contain lime sequestering agents to tie up the mineral content effectively in the water and minimize its deposition on surfaces. In addition, it should possess germicidal and fungistatic properties to enable it to combat slime growths in the sump tank, on coils, eliminators and other surfaces. Its solutions must also be non-toxic and odorless.

The solution in the sump should not fall below recommended concentrations. Titration should be performed periodically and additions made as required. Keeping concentrations at the proper level will automatically take care of the pH, which should range between 8 and 9 for best results. Regular use of such a material will keep the system in a clean, sweet condition so that the need for cleaning and descaling is substantially reduced. The alkalinity of the solution also serves to prevent corrosion of surfaces.

Filters

Other units in the air conditioning system requiring attention are the various types of air filters used for

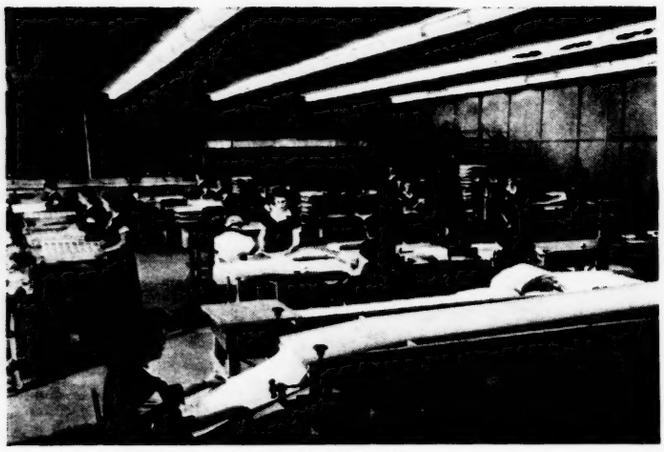
removing dust from the air. Some of these are intended to be thrown away when too dirty for further use. If they are washable, however, they may be cleaned by immersing them, dirty side up, in a heated solution of an alkaline material for approximately 10 or 15 minutes. Agitating the filters will help the cleaning. After the filters are removed from the cleaning tank they should be drained and dried.

Other filters are of the automatic self-cleaning type. They consist of an endless vertical roller-type chain, belt or curtain made up of oil-impregnated metallic cloth, overlapping panel flaps, baffles or filter sections arranged over a top and bottom sprocket. The filter curtain is revolved periodically, controlled by an automatic timing device. Thus the curtain continuously presents a new surface to the air stream while the soiled section passes through a reservoir of oil at the base of the unit where entrapped dust, lint, etc., are removed by the oil bath.

After a period of operation, the mesh openings in the filters eventually become fouled and the filter system has to be cleaned. One method of cleaning is to drain the oil reservoir and muck out the bottom of the tank, then charge the tank with a solution of a moderately strong alkaline cleaner. The curtain is then rotated through the solution, which may be kept warm by introducing live steam. After the cleaning the reservoir should be drained, filled with fresh water and the curtain revolved through the tank to rinse. The reservoir is then drained and filled with new oil.

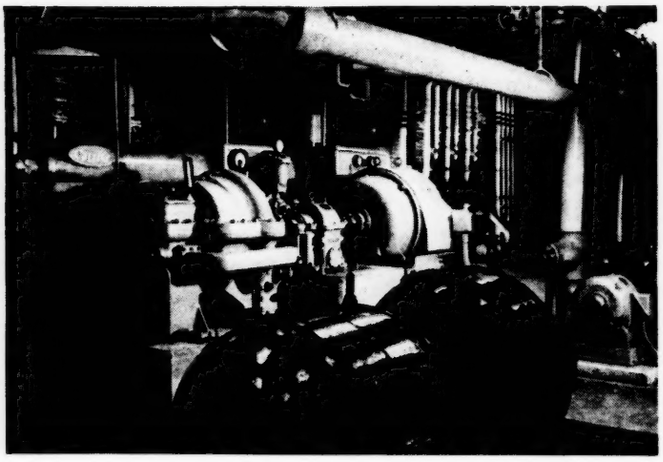
Another job to be considered is the cleaning and descaling of water-cooled compressors and, here again, the use of proper cleaning materials will eliminate tedious hand labor and reach surfaces that might not be touched by other methods. Most of the reputable cleaning material manufacturers are thoroughly familiar with this type of work and their recommendations and assistance will prove of inestimable value for putting various cleaning operations on a speedy, efficient and economical basis.

Air Conditioning a Must for Making Money

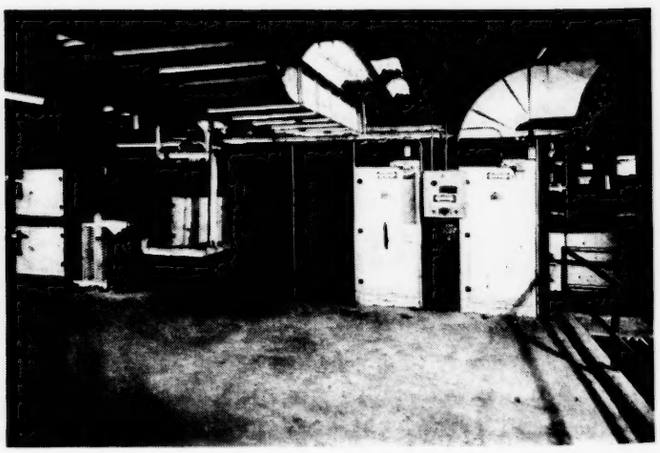


High grade security products are manufactured in the British American Bank Note Co., Ltd.'s new plant erected by the Austin Co., Ltd., at Ottawa, Canada. Alternate wetting and drying of paper in process must be handled under closest atmospheric controls. Special air conditioning equipment for this area operates independently.

Paper for use in bank note printing is conditioned in three humidors like this which open directly into the wetting and drying room. Each of the units is served by a separate installation of cooling and humidifying equipment which automatically maintains the conditions required to ensure accurate register.



This 350-ton Carrier centrifugal refrigerating compressor provides cooling for most of the production areas and offices. Additional refrigeration is provided by separate units serving specialized sections of the plant.



Air conditioning equipment serving the offices and engraving and transfer departments is located on this mezzanine platform directly above the plant entrance and reception lobby. Facilities include electrostatic filters.

Heating Today's Industrial Plant

C. P. STOLBERG

Chief Mechanical Engineer, The H. K. Ferguson Co.

Industrial heating systems in current vogue are reviewed with the author's own estimate of the advantages and disadvantages of each.

THE industrial designer of today must face the complex problem of providing efficient and modern heating systems to match the streamlined and multi-million dollar process and manufacturing equipment being installed in new industrial plants. Heating standards have gone up and, further, industry is demanding that the heating engineer undertake the solution of special problems in ventilation, humidity control, dust and fume removal and cooling, not heretofore considered a part of heating or so widely required by industry. Labor is insisting on better and safer working conditions. Product standards have gone up requiring better control of plant conditions. Management is becoming increasingly aware of the benefits of a clean and comfortable plant. Safety requirements are higher. All the new processes are injecting into the heating picture new and more complicated air problems for the heating engineer. These demands for better heating must be met, and will be met, partially by the availability of some new heating equipment but mostly by the better utilization of existing types of equipment and better engineering.

It is not possible to discuss here all the special heating problems that confront the industrial designer, for they are much too varied and have very specific applications in each type of plant. There are, however, general trends in modern industrial heating that can be reviewed and clarified to assist in determining, from the overall standpoint, the most adaptable and satisfactory system for any particular plant. It is to be remembered that there is no rule of thumb that can be applied to any problem because of the variables and ramifications always present, but, rather, that good common sense coupled with imagination and careful engineering are the real requisites of a satisfactory solution.

Industrial heating can be grouped into four big families arranged in order of their prevalence today as follows:

1—Steam systems
2—Warm air systems
3—Direct-fired heater systems
4—Hot water systems

A combination of steam and warm air systems is found in the so-called hot blast system where air is heated centrally by being blown over a steam coil and then is ducted to the working space. Direct-fired systems, too, are sometimes used with ducts and hence take on the characteristics of conventional warm air systems.

As a commentary on the good engineering and intelligent planning on the part of modern industrial management, the prevalence of use of the various systems in the heating families is not determined by first cost alone, for, arranged according to installation cost (the least expensive first) they are as follows:

1—Direct-fired heater systems
2—Steam systems
3—Hot water systems
4—Warm air systems

The cost of operation is an entirely separate problem depending largely on the cost of various fuels in different localities, cost of labor, availability of maintenance service, and the size of the plant and resulting size and scope of the heating system.

Using coal as a fuel favors the use of steam heating and impedes the use of direct-fired oil or gas heating equipment. There is, of course, direct-fired coal equipment available, but, if coal is utilized for direct firing the cost advantages of oil and gas direct-fired equipment disappear and the steam system re-enters the cost picture with its inherent advantages.

Steam Heating Systems

Steam heating still retains its strong first position in the number of new industrial heating installations being made. However, the changes within the steam heating family itself are many. New equipment has forged a place for itself and new types of systems and layouts are being installed.

Steam heat is available for industry in the following basic forms (listed in order of their use in new installations today):

1—Unit heaters
2—Convector-radiators with sheet metal enclosures
3—Continuous steel finned pipe radiation
4—Cast-iron radiators
5—Steel radiators
6—Radiant heating
7—Pipe coils

Steam unit heaters continue to do a large share of the nation's industrial heating. New outlets and better air distributing characteristics of the newer outlet vanes have corrected most of the earlier objections to the down blow heater and assisted this type in forging ahead. Their cost is competitive and most designs are basically excellent.

The other major trend in unit heater installations is the use of higher steam pressures, particularly with down blow units. Pressures of 50 lb per sq in. are commonplace and 100 lb per sq in. designs are immi-

ment. These higher pressures reduce the heater size and cost, and also result in substantial savings in the cost of piping even though heavier pipe insulation may be required.

The so-called and well named "fresh air unit heaters," providing ventilation with filtered air, have filled a real need and are being utilized extensively in some industries where heated and filtered air is required.

Convector-radiators have lately assumed a prominent position in industrial heating. In plant offices, tool rooms, locker rooms, control rooms, etc., and where stationary or sedentary workers are located near large expanses of window glass, the convector-radiator is a very realistic solution to the heating problem. They can be readily combined with the unit heater system in the remainder of the plant because higher steam pressures can be utilized, thus requiring only one steam distribution system for the entire plant. High pressure condensate, resulting from the use of high pressure steam usually simplifies condensate handling problems, particularly in one-story plants.

Where plant employees work constantly near windows, particularly near large areas of continuous sash, convectors under the glass will interrupt cold drafts and result in satisfactory conditions. These cold floor drafts, originating at the windows in plants with improperly designed heating systems, are recognized as the greatest source of trouble in industrial heating.

Continuous steel finned pipe radiation is, comparatively speaking, a newcomer in the industrial heating field. Its inherent advantages are analogous to those of convector-radiators previously described. Finned radiation can be easily used with high pressure steam, can be installed in conjunction with unit heaters, and will be found particularly efficient in offsetting window drafts. It usually results in an installation less expensive than convector-radiators. With continuous wall or monitor sash, this type of radiation can be installed continuously under the glass at the sill and will perform very effectively.

A few difficulties have arisen in use of finned radiation. It is necessary to design for expansion in long runs; runs too lengthy develop circulation troubles; and individual sections under separate control must be used for each space or room.

The use of this finned pipe material for industrial heating received a tremendous impetus during the war because its availability was comparatively good and the trend toward its use is now continuing with great strength.

Cast-iron radiators received a serious setback during the war because of delivery problems occasioned by foundry difficulties. The gains made by convectors, continuous steel finned pipe radiation and steel radiators were partially made at the expense of the cast-iron radiator. In modern industrial design, it is felt that the future for cast-iron radiation is not too bright, due to the serious competition being offered by heating equipment recently developed.

The general usage for cast-iron radiators is analogous to that described for convector-radiators and, as far as heating characteristics are concerned, the advantages and disadvantages of both types are very similar. In cast-iron radiation, of course, steam pressures are limited to 15 lb per sq in.

Steel radiators have the basic advantages of convector-radiators, but are considerably more expensive and occupy more space. Their advantages over convectors are that steel radiators may be used with very high steam pressures and will withstand much abuse. While steel radiation probably is holding its position in industrial heating today, it certainly faces vigorous competition in the immediate future.

Radiant heating is the infant prodigy of the industrial heating field. Few steam installations and much discussion are in evidence, and, in general, hot water is considered a better medium for use with radiant heating. Some systems have used steam in heat exchangers to heat water for circulation in radiant heating panels. A number of plant offices and locker rooms are radiantly heated with steam, but relatively few actual factory and plant installations have been made. First cost of radiant heating installations tends to be high; temperature control may be extremely difficult for large factory areas; expansion, pipe corrosion and maintenance problems have not been completely solved; and the use of warm floors in some industries, particularly those handling food, is questioned by some designers.

Radiant heating, however, definitely has an industrial future. As its problems are reconciled and the cost reduced, we shall see an expanding of the application possibilities and a rapid increase in the number of industrial installations.

Pipe coils are being avoided by the modern industrial designer as costly and ineffective heating equipment. In fact, the only excuse for ever using pipe coils apparently was when a plant engineer had an excess of old pipe he couldn't use elsewhere and a few steamfitters with nothing else to do.

Warm Air Systems

Warm air heating systems in industry have suffered seriously in the past in competition with steam systems—particularly with unit heaters. Often process steam is piped throughout a building and it is relatively simple and inexpensive to connect unit heaters or radiators to the process steam lines. Warm air ducts in a large plant mean a separate distribution system, occupy a lot of space and, even when they are installed up in the roof trusses, they will often interfere with lighting, sprinklers and process piping as well as overhead bridge crane operation. In some types of construction duct work will blank off monitor daylight. Working out an efficient duct distribution system is a difficult job in most plants, requiring close cooperation with all the other trades and careful planning.

There are, however, many advantages in a warm air system, and often it evolves as the only solution to a difficult heating problem. The advent of air conditioning in industry encourages the use of the warm air system, for the same air duct system can be utilized for both winter heating and summer cooling. Other industries require controlled humidity and temperature, and the warm air duct system is about the only real answer for the problem. There is often a

need for clean filtered air at all times or for replacement air due to large process air exhausts—all of these requirements are met successfully by an air distribution system.

The special problems of modern industry and the further demands for better product standards, safety, better plant working conditions and controlled process conditions have all greatly increased the scope of the warm air system and have accelerated its use. Where straight heating is satisfactory, the steam system will prevail, but, where special air handling problems are involved, the warm air system will be indicated and often required. The use of warm air for heating is on the increase and will continue to increase as long as industrial requirements mount.

It is often advisable to use a warm air heating system for the plant offices and locker rooms while the rest of the plant is heated by unit heaters. This is a realistic solution to the office comfort problem and does not affect the expenditures for large plant areas.

Direct-fired heating systems fall generally into two main divisions — those utilizing an air distribution system in conjunction with a direct-fired unit, and those using direct-fired heating equipment in the space to be heated without duct work of any kind. The former is directly comparable to the warm air system previously discussed.

Direct-Fired Systems

During the war direct-fired heating equipment with air duct distribution systems was quite extensively installed for heating large buildings such as airplane hangars. The use of this type of an installation was encouraged because of the critical war shortage of steam generating equipment. However, many of these war emergency installations were surprisingly successful, providing efficient heating at low cost.

Two types of air distribution systems are generally used in conjunction with direct-fired heating units—one is the under-floor duct system, usually constructed in concrete, and the other is the sheet metal duct work overhead distribution system. The under-floor system may have outlets at the columns, or along the outside building walls under the windows. Although difficult and costly to form in concrete, results have been quite successful, particularly where long narrow strip outlets at comparatively high velocity actually form a rising warm air curtain which prevents large masses of cold air from entering the buildings at the floor line when the doors are opened.

This under-floor concrete duct construction is relatively very expensive and was used during the war largely because of the shortage of metal for overhead sheet metal duct systems. With careful planning, however, the under-floor system can be held down in cost.

The overhead sheet metal air distribution system for direct-fired unit heating, is substantially the same as that employed in the warm air system previously described. The inherent disadvantages are also present. The overhead system interferes with lighting, sprinklers and overhead cranes, and it is difficult to heat from overhead outlets if large expanses of window glass are present. The overhead sheet metal distribution system is also relatively expensive and at the present time sheet steel for duct construction is very difficult to obtain.

The use of direct-fired heaters, without a duct distribution system, usually results in a very inexpensive installation. The hot air is blown directly from the units into the space to be heated. In order to obtain acceptable air distribution in a large space, the size of the units must be kept down and the number of units increased. This complicates temperature control somewhat and results in duplication of some of the equipment. A direct-fired unit heating system without duct work can be used successfully in large open buildings, such as boiler shops, or where heavy manufacturing is being carried on. In other words, where the work is heavy and where the men are well clothed and active, the ultimate in control of temperature and air distribution is not too essential.

Direct-fired heating units can be fired with oil, gas or coal. They are much more adaptable to oil and gas, of course, because of the disadvantage of handling coal and ashes from a number of isolated spots. The use of coal is almost impossible where a duct distribution system is not used and a larger number of units are necessary. However, if one central station can be utilized, coal for a direct-fired system is no more difficult to handle than it is in a central boiler installation.

In general it is felt that this type of heating, while it has definite limitations, will always have some specific applications where it can be successfully employed. The use of direct-fired heating is characterized by the fact that multiple single units are inexpensive, while larger units with duct distribution systems are expensive, putting them in direct competition with steam and other forms of central heating. Where large open shops are to be heated, this type of a system should always be given consideration.

Hot Water

Hot water heating systems are first cousins to the steam heating systems. With minor variations the same equipment can be utilized and the general results are much the same. A great deal of discussion has evolved on the merits of steam versus hot water and it is doubtful whether any conclusive decision will ever be made as to which is the most advantageous. Steam is faster, requires smaller pipe lines and a little less expensive generating equipment. Hot water is smoother, quieter, resulting in more uniform heat and condensate problems are not incurred. Each has its own advantages and the choice is usually made on the price basis in favor of steam. A great deal of good work has been done by manufacturers of equipment to control and regulate the flow of hot water to produce excellent results. The old disadvantages of poor circulation in gravity hot water systems have been almost completely overcome by improved designs.

Hot water has been used extensively in the radiant heating field, and most manufacturers and engineers now agree that it is a better radiant heating medium than steam. The use of radiant heating probably presents the best future for hot water heating inasmuch as it is felt that radiant heating itself has a very excellent future.

Hot water may be generated in two ways—one by generating steam and then using the steam in a conventional heat exchanger to heat the water; and the other, using a boiler which is controlled to generate only hot water and circulating this boiler water directly in the heating system. The latter type of installation, where the boiler water is circulated directly, is limited in size, as it has been found difficult to employ large boilers in this way. To circulate hot water a pump should be used, as it is generally felt today that gravity circulation systems are undesirable. Therefore, possibly the use of heat exchangers and pumps increase the complexity and cost of a hot water installation as against a steam job.

Some experimental work and a few installations have been made in this country, using high temperature, high pressure water over 212F. Although quite common in Europe, where much more effort is made to save material than in the United States, these high temperature systems have not had much vogue in this country.

The control of hot water heating systems is substantially the same as that described for steam and is usually a little simpler and little more accurate. Where constant temperature requirements are severe, hot water is often a better solution than steam although at a greater cost. Hot water may be used in unit heaters, convector-radiators, continuous steel-finned pipe radiation, cast-iron radiators, steel radiators, radiant heating systems and pipe coils—in other words, it can be used wherever steam is used if the proper conversion factors are used. Hot water will always be a good heating medium and, although many more steam installations will be made, this will be because of the advantage of steam over hot water in ultimate cost and the fact that steam is more readily available in most industrial plants.

Conclusions

The intent of this review of the modern trends in industrial heating has not been to make a recommendation or plea for any particular type of system, but rather to discuss the general trends of new industrial installations. It is felt that it is very important to emphasize that no cure-all, or rule of thumb, can be applied to every design problem. The best results in heating will always be obtained by the application of careful and imaginative engineering to each particular problem to the end that the best possible installation is made for each individual requirement. By watching trends some benefit may be obtained by the experience of others. The cost picture also is continually changing and influencing the installation trend. New products are being developed and their application will and should affect the choice of the engineer on each new installation. It is one of the primary duties of the designer to acquaint himself with the new equipment being made available, follow the changes in the cost picture, and also follow the development of modern trends in order to best serve the industrial plant owners and advance the heating industry as a whole.

Heating Industry Mobilizes for Emergency

HEATING INDUSTRY IN MOBILIZATION PLANNING—To help in developing smoother methods of mobilizing productive effort in the event of another emergency, the National Security Resources Board is enlisting the cooperation of scores of informal task groups from specialized segments of industry. Among them is this group representing manufacturers of temperature and combustion controls and specialties for heating systems, which met recently in Washington. Informal suggestions of the various task groups later will be consolidated into comprehensive mobilization plans which will be reviewed by formal industry-wide advisory committees before being passed upon by the board itself for transmission for the President's consideration. Shown here (left to right) are: L. W. McCrea, Hoffman Specialty Co., Indianapolis, Ind.; C. W. Nessell, Minneapolis-Honeywell, Minneapolis, Minn.; W. L. Huff, Minneapolis-Honeywell, Minneapolis, Minn.; L. H. Hobson, sales manager, Automatic Heating Div., General Electric Co., Bloomfield, N. J.; Harold Marshall, Warren Webster & Co., Camden, N. J.; A. E. Hess, managing director, Oil Heat Institute of America, New York; J. P. Kottcamp, NSRB's director of the Construction Materials Division; Walter R. Crowe, Construction Materials Division, NSRB; H. F. Collins, Sarco Co., Inc., New York; J. A. Rodgers, president, White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 11, Mo.; Malcolm E. Henning, Penn Electric Switch Co., Goshen, Ind.; V. R. Tate, Perfex Corp., Milwaukee, Wis.

Tabular Determination of the Overall Coefficient of Heat Transfer for Pipes and Tubes

B. F. RABER* and F. W. HUTCHINSON**

The authors present tables for convenient calculation of the overall heat transfer through pipes and tubes, knowing the inside and outside film coefficients. Sixteen previous articles were devoted to the graphical determination of the film coefficients for sixteen different refrigerants. Subsequent articles will be devoted to the vapor of certain fluids.

WHEN steady state heat transfer occurs between two fluids within and outside of a pipe or tube the equation for evaluation of the transfer rate can be written in terms either of an overall coefficient of heat transmission, U in Btu per (hr) (sq ft), or in terms of the total thermal resistance, R, which is numerically equal to the reciprocal of the overall coefficient. The transfer rate is then,

$$q = UA(t_h - t_c) = \frac{A(t_h - t_c)}{R} \qquad (1)$$

where t_h and t_c are the temperatures of the hot and the cold fluids, respectively, and A is the area of the transfer surface expressed in square feet. The numerical values of both U and R in the above equation depend on whether A is taken as the inside or outside surface area of the pipe. For many purposes a more effective transfer equation can be written in terms of U' and R' as,

$$q = U'(t_h - t_c) = \frac{t_h - t_c}{R'} \qquad (2)$$

in which,

$$U' = \frac{1}{1/h_i A_i + L/kA_p + 1/h_o A_o} = \frac{1}{R'} \qquad (3)$$

where h_i and h_o are, respectively, the inside and outside film coefficients of heat transfer expressed in Btu per (hr) (sq ft) (°F), L is the thickness of the pipe wall in inches and k is the thermal conductivity of the pipe expressed in Btu per (hr) (sq ft) (°F/inch); the areas A_i, A_o, A_p are of inside and outside pipe surface and the mean area of the pipe wall; the latter area is usually taken as 2π times the pipe length times the log mean radius of the pipe.

In many types of practical heat transfer equipments the pipe wall resistance is such a very small part of the total resistance that it can be neglected and the total resistance to heat transfer then considered to be the resistance of the inside and outside films. Further, with thin-walled tubes of moderate diameter the difference in area between inside and outside surface is insignificant and the total resistance of the system is then practically equal to the sum of inside and outside film resistances where each of these is based on the actual area over which the film occurs.

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TABLE 1a. VALUES OF R FOR INSIDE FILM COEFFICIENTS FROM 1 TO 40

Outside Film Coefficient, h_o	Inside Film Coefficient, h_i											
	1	2	4	6	8	10	15	20	25	30	35	40
	Value of R											
1	2.000	1.500	1.250	1.167	1.125	1.100	1.0667	1.0500	1.0400	1.0333	1.0286	1.0250
2	—	1.000	.7500	.6670	.6250	.6000	.5667	.5500	.5400	.5333	.5286	.5250
4	—	—	.5000	.4170	.3750	.3500	.3167	.3000	.2900	.2833	.2786	.2750
6	—	—	—	.3340	.2920	.2670	.2337	.2170	.2070	.2003	.1956	.1920
8	—	—	—	—	.2500	.2250	.1917	.1750	.1650	.1583	.1536	.1500
10	—	—	—	—	—	.2000	.1667	.1500	.1400	.1333	.1286	.1250
15	—	—	—	—	—	—	.1334	.1167	.1067	.1000	.0953	.0917
20	—	—	—	—	—	—	—	.1000	.0900	.0833	.0786	.0750
25	—	—	—	—	—	—	—	—	.0800	.0733	.0686	.0653
30	—	—	—	—	—	—	—	—	—	.0666	.0619	.0583
35	—	—	—	—	—	—	—	—	—	—	.0572	.0536
40	—	—	—	—	—	—	—	—	—	—	—	.0500

TABLE 1b and 1c. VALUES OF R FOR INSIDE FILM COEFFICIENTS FROM 45 TO 450

Table 1b. Inside Film Coefficient, h_i

Outside Film Coefficient, h_o	45	50	60	70	80	90	100	120	140	160	180
	Value of R										
1	1.0220	1.0200	1.0167	1.0143	1.0125	1.0111	1.0100	1.00833	1.00714	1.00625	1.00555
2	.5220	.5200	.5167	.5143	.5125	.5111	.5100	.5083	.5071	.5062	.5055
4	.2720	.2700	.2667	.2643	.2625	.2611	.2600	.2583	.2571	.2562	.2555
6	.1890	.1870	.1837	.1813	.1795	.1781	.1770	.1753	.1741	.1732	.1725
8	.1470	.1450	.1417	.1393	.1375	.1361	.1350	.1333	.1321	.1312	.1305
10	.1220	.1200	.1167	.1143	.1125	.1111	.1100	.1083	.1071	.1062	.1055
15	.0887	.0867	.0834	.0810	.0792	.0778	.0767	.0750	.0738	.0729	.0722
20	.0720	.0700	.0667	.0643	.0625	.0611	.0600	.0583	.0671	.0562	.0555
25	.0622	.0600	.0567	.0543	.0525	.0511	.0510	.0483	.0471	.0462	.0455
30	.0553	.0533	.0500	.0476	.0458	.0444	.0433	.0416	.0404	.0395	.0388
35	.0506	.0486	.0453	.0429	.0411	.0397	.0386	.0369	.0357	.0348	.0341
40	.0470	.0450	.0417	.0393	.0375	.0361	.0350	.0333	.0321	.0312	.0305
45	.0440	.0420	.0387	.0365	.0345	.0331	.0320	.0303	.0291	.0282	.0275
50	—	.0400	.0367	.0343	.0325	.0311	.0300	.0283	.0271	.0262	.0255
60	—	—	.0334	.0310	.0292	.0278	.0267	.0250	.0238	.0229	.0222
70	—	—	—	.0286	.0268	.0254	.0243	.0226	.0214	.0205	.0198
80	—	—	—	—	.0250	.0236	.0225	.0208	.0196	.0187	.0180
90	—	—	—	—	—	.0222	.0211	.0194	.0182	.0173	.0166
100	—	—	—	—	—	—	.0200	.0183	.0171	.0162	.0155
120	—	—	—	—	—	—	—	.0167	.0155	.0146	.0139
140	—	—	—	—	—	—	—	—	.0143	.0134	.0127
160	—	—	—	—	—	—	—	—	—	.0125	.0118
180	—	—	—	—	—	—	—	—	—	—	.0111

Table 1c. Inside Film Coefficient, h_i

Outside Film Coefficient, h_o	200	225	250	275	300	325	350	375	400	425	450
	Value of R										
1	1.00500	1.00444	1.0040	1.00364	1.00333	1.00308	1.00286	1.00267	1.00250	1.00235	1.00222
2	.5050	.5044	.5040	.5036	.5033	.5031	.5029	.5027	.5025	.5023	.5022
4	.2550	.2544	.2540	.2536	.2533	.2531	.2529	.2527	.2525	.2523	.2522
6	.1720	.1714	.1710	.1706	.1703	.1701	.1699	.1697	.1695	.1693	.1692
8	.1300	.1294	.1290	.1286	.1283	.1281	.1279	.1277	.1275	.1273	.1272
10	.1050	.1044	.1040	.1036	.1033	.1031	.1029	.1027	.1025	.1023	.1022
15	.0717	.0711	.0707	.0703	.0700	.0698	.0696	.0694	.0692	.0690	.0689
20	.0550	.0544	.0540	.0536	.0533	.0531	.0529	.0527	.0525	.0523	.0522
25	.0450	.0444	.0440	.0436	.0433	.0431	.0429	.0427	.0425	.0423	.0422
30	.0383	.0377	.0373	.0369	.0366	.0364	.0362	.0360	.0358	.0356	.0355
35	.0336	.0330	.0326	.0322	.0319	.0317	.0315	.0313	.0311	.0309	.0308
40	.0300	.0294	.0290	.0286	.0283	.0281	.0279	.0277	.0275	.0273	.0272
45	.0270	.0264	.0260	.0256	.0253	.0251	.0249	.0247	.0245	.0243	.0242
50	.0250	.0244	.0240	.0236	.0233	.0231	.0229	.0227	.0225	.0223	.0222
60	.0217	.0211	.0207	.0203	.0200	.0198	.0196	.0194	.0192	.0190	.0189
70	.0193	.0187	.0183	.0179	.0176	.0174	.0172	.0170	.0168	.0166	.0165
80	.0175	.0169	.0165	.0161	.0158	.0156	.0154	.0152	.0150	.0148	.0147
90	.0161	.0155	.0151	.0147	.0144	.0142	.0140	.0138	.0136	.0134	.0133
100	.0150	.0144	.0140	.0136	.0133	.0131	.0129	.0127	.0125	.0123	.0122
120	.0133	.0128	.0123	.0120	.0117	.0115	.0113	.0111	.0109	.0107	.0106
140	.0121	.0116	.0111	.0108	.0105	.0103	.0101	.00981	.00964	.00949	.00936
160	.0112	.0107	.0102	.00989	.00958	.00933	.00911	.00892	.00875	.00860	.00847
180	.0105	.00999	.00955	.00919	.00888	.00863	.00841	.00822	.00805	.00790	.00777
200	.0100	.00944	.00900	.00864	.00833	.00808	.00786	.00767	.00750	.00735	.00722
225	—	.00888	.00844	.00808	.00777	.00752	.00730	.00711	.00694	.00679	.00666
250	—	—	.00800	.00764	.00733	.00708	.00686	.00667	.00650	.00635	.00622
275	—	—	—	.00728	.00697	.00672	.00650	.00631	.00614	.00599	.00586
300	—	—	—	—	.00666	.00641	.00619	.00600	.00583	.00568	.00555
325	—	—	—	—	—	.00616	.00594	.00575	.00558	.00543	.00530
350	—	—	—	—	—	—	.00572	.00553	.00536	.00521	.00508
375	—	—	—	—	—	—	—	.00534	.00517	.00502	.00489
400	—	—	—	—	—	—	—	—	.00500	.00485	.00472
425	—	—	—	—	—	—	—	—	—	.00470	.00457
450	—	—	—	—	—	—	—	—	—	—	.00444

TABLE 1d. VALUES OF R FOR INSIDE FILM COEFFICIENTS FROM 475 TO 950

Outside Film Coefficient, h_o	Inside Film Coefficient, h_i										
	475	500	550	600	650	700	750	800	850	900	950
	Value of R										
1	1.00210	1.00200	1.00182	1.00167	1.00154	1.00143	1.00133	1.00125	1.00118	1.00111	1.00105
2	.5021	.5020	.5018	.5017	.5015	.5014	.5013	.5012	.5012	.5011	.5010
4	.2521	.2520	.2518	.2517	.2515	.2514	.2513	.2512	.2512	.2511	.2510
6	.1691	.1690	.1688	.1687	.1685	.1684	.1683	.1682	.1682	.1681	.1680
8	.1271	.1270	.1268	.1267	.1265	.1264	.1263	.1262	.1262	.1261	.1260
10	.1021	.1020	.1018	.1017	.1015	.1014	.1013	.1012	.1012	.1011	.1010
15	.0688	.0687	.0685	.0684	.0682	.0681	.0680	.0679	.0679	.0678	.0677
20	.0521	.0520	.0518	.0517	.0515	.0514	.0513	.0512	.0512	.0511	.0510
25	.0421	.0420	.0418	.0417	.0415	.0414	.0413	.0412	.0412	.0411	.0410
30	.0354	.0353	.0351	.0350	.0348	.0347	.0346	.0345	.0345	.0344	.0343
35	.0307	.0306	.0304	.0303	.0301	.0300	.0299	.0298	.0298	.0297	.0296
40	.0271	.0270	.0268	.0267	.0265	.0264	.0263	.0262	.0262	.0261	.0260
45	.0241	.0240	.0238	.0237	.0235	.0234	.0233	.0232	.0232	.0231	.0230
50	.0221	.0220	.0218	.0217	.0215	.0214	.0213	.0212	.0212	.0211	.0210
60	.0188	.0187	.0185	.0184	.0182	.0181	.0180	.0179	.0179	.0178	.0177
70	.0164	.0163	.0161	.0160	.0158	.0157	.0156	.0155	.0155	.0154	.0153
80	.0146	.0145	.0143	.0142	.0140	.0139	.0138	.0137	.0137	.0136	.0135
90	.0132	.0131	.0129	.0128	.0126	.0125	.0124	.0123	.0123	.0122	.0121
100	.0121	.0120	.0118	.0117	.0115	.0114	.0113	.0112	.0112	.0111	.0110
120	.0105	.0104	.0102	.0101	.00987	.00976	.00966	.00958	.00951	.00944	.00938
140	.00924	.00914	.00896	.00881	.00868	.00857	.00847	.00839	.00832	.00825	.00819
160	.00835	.00825	.00807	.00792	.00779	.00768	.00758	.00750	.00743	.00736	.00730
180	.00765	.00755	.00737	.00722	.00709	.00698	.00688	.00680	.00673	.00666	.00660
200	.00710	.00700	.00682	.00667	.00654	.00643	.00633	.00625	.00618	.00611	.00605
225	.00650	.00644	.00626	.00611	.00598	.00587	.00577	.00569	.00562	.00555	.00549
250	.00610	.00600	.00582	.00567	.00544	.00543	.00533	.00525	.00518	.00511	.00505
275	.00574	.00564	.00546	.00540	.00514	.00507	.00497	.00489	.00482	.00475	.00469
300	.00543	.00533	.00515	.00500	.00487	.00476	.00466	.00458	.00451	.00444	.00438
325	.00518	.00508	.00490	.00475	.00452	.00451	.00441	.00433	.00426	.00419	.00413
350	.00496	.00486	.00468	.00453	.00440	.00429	.00419	.00411	.00404	.00397	.00391
375	.00477	.00467	.00449	.00434	.00421	.00410	.00400	.00392	.00385	.00378	.00372
400	.00460	.00450	.00432	.00417	.00404	.00393	.00383	.00375	.00368	.00361	.00355
425	.00445	.00435	.00417	.00402	.00389	.00378	.00368	.00360	.00353	.00346	.00340
450	.00432	.00422	.00404	.00389	.00376	.00365	.00355	.00347	.00340	.00333	.00327
475	.00420	.00410	.00392	.00377	.00364	.00353	.00343	.00335	.00328	.00321	.00315
500	—	.00400	.00382	.00367	.00354	.00343	.00333	.00325	.00318	.00311	.00305
550	—	—	.00364	.00349	.00336	.00325	.00315	.00307	.00300	.00293	.00287
600	—	—	—	.00334	.00321	.00310	.00300	.00292	.00285	.00278	.00272
650	—	—	—	—	.00308	.00297	.00287	.00279	.00272	.00265	.00259
700	—	—	—	—	—	.00286	.00276	.00268	.00261	.00254	.00248
750	—	—	—	—	—	—	.00266	.00258	.00251	.00244	.00238
800	—	—	—	—	—	—	—	.00250	.00243	.00236	.00230
850	—	—	—	—	—	—	—	—	.00236	.00229	.00223
900	—	—	—	—	—	—	—	—	—	.00222	.00216
950	—	—	—	—	—	—	—	—	—	—	.00210

When simplification of this kind is permissible the equation for the R term of equation 1 becomes,

$$R = \frac{1}{h_i} + \frac{1}{h_o} \qquad (4)$$

When the wall thickness is not so small as to be negligible an equation for total resistance can be written in terms of the outside surface area as,

$$R_o = \frac{1}{\frac{1}{h_i(A_i/A_o)} + \frac{1}{1/h_o}} \qquad (5)$$

or an equation in terms of inside area can be written as,

$$R_i = \frac{1}{\frac{1}{h_i} + \frac{1}{h_o(A_o/A_i)}} \qquad (6)$$

Equations 5 and 6 can be more conveniently written in the same form as equation 4,

$$R_o = 1/h'_i + 1/h_o = \frac{1}{h'_i} + \frac{1}{h_o} \qquad (5a)$$

$$R_i = 1/h_i + 1/h'_o = \frac{1}{h_i} + \frac{1}{h'_o} \qquad (6a)$$

TABLE 1e. VALUES OF R FOR INSIDE FILM COEFFICIENTS FROM 1000 TO 2000

Outside Film Coefficient, h_o	Inside Film Coefficient, h_i										
	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
	Value of R										
1	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.000	1.000	1.000	1.000
2	.5010	.5009	.5008	.5008	.5007	.5007	.5006	.5006	.5005	.5005	.5005
4	.2510	.2509	.2508	.2508	.2507	.2507	.2506	.2506	.2505	.2505	.2505
6	.1680	.1679	.1678	.1678	.1677	.1677	.1676	.1675	.1675	.1675	.1675
8	.1260	.1259	.1258	.1258	.1257	.1257	.1256	.1255	.1255	.1255	.1255
10	.1010	.1009	.1008	.1008	.1007	.1007	.1006	.1006	.1005	.1005	.1005
15	.0677	.0676	.0668	.0668	.0668	.0668	.0668	.0667	.0667	.0667	.0667
20	.0510	.0509	.0508	.0508	.0507	.0507	.0506	.0506	.0505	.0505	.0505
25	.0410	.0409	.0408	.0408	.0407	.0407	.0406	.0406	.0405	.0405	.0405
30	.0343	.0342	.0341	.0341	.0340	.0340	.0339	.0339	.0338	.0338	.0338
35	.0296	.0295	.0294	.0294	.0293	.0293	.0292	.0292	.0291	.0291	.0291
40	.0260	.0259	.0258	.0258	.0257	.0257	.0256	.0256	.0255	.0255	.0255
45	.0230	.0229	.0228	.0228	.0227	.0227	.0226	.0226	.0225	.0225	.0225
50	.0210	.0209	.0208	.0208	.0207	.0207	.0206	.0206	.0205	.0205	.0205
60	.0177	.0176	.0175	.0175	.0174	.0174	.0174	.0174	.0173	.0173	.0173
70	.0153	.0152	.0151	.0151	.0150	.0150	.0150	.0150	.0149	.0149	.0149
80	.0135	.0134	.0133	.0133	.0132	.0132	.0132	.0132	.0131	.0131	.0131
90	.0121	.0120	.0119	.0119	.0118	.0118	.0118	.0118	.0117	.0117	.0117
100	.0110	.0109	.0108	.0108	.0107	.0107	.0107	.0107	.0106	.0106	.0106
120	.00933	.00924	.00916	.00910	.00904	.00900	.00895	.00892	.00888	.00886	.00883
140	.00814	.00805	.00797	.00791	.00785	.00781	.00776	.00773	.00769	.00767	.00764
160	.00725	.00716	.00708	.00702	.00696	.00692	.00686	.00683	.00679	.00677	.00674
180	.00655	.00646	.00638	.00636	.00630	.00626	.00600	.00597	.00593	.00591	.00588
200	.00600	.00591	.00583	.00577	.00571	.00567	.00562	.00559	.00555	.00553	.00550
225	.00544	.00535	.00527	.00521	.00515	.00511	.00506	.00503	.00499	.00497	.00494
250	.00500	.00491	.00483	.00477	.00471	.00467	.00462	.00459	.00455	.00453	.00450
275	.00464	.00455	.00447	.00441	.00435	.00431	.00426	.00423	.00419	.00417	.00414
300	.00433	.00423	.00416	.00410	.00404	.00400	.00395	.00392	.00388	.00386	.00383
325	.00408	.00399	.00391	.00385	.00379	.00375	.00370	.00367	.00363	.00361	.00358
350	.00386	.00377	.00369	.00363	.00357	.00353	.00348	.00345	.00341	.00339	.00336
375	.00367	.00358	.00350	.00344	.00338	.00334	.00329	.00326	.00322	.00320	.00317
400	.00350	.00341	.00333	.00327	.00321	.00317	.00312	.00309	.00305	.00303	.00300
425	.00335	.00326	.00318	.00312	.00306	.00302	.00297	.00294	.00290	.00288	.00285
450	.00322	.00313	.00305	.00299	.00293	.00289	.00284	.00281	.00277	.00275	.00272
475	.00310	.00301	.00293	.00287	.00281	.00277	.00272	.00269	.00265	.00263	.00260
500	.00300	.00291	.00283	.00277	.00271	.00267	.00262	.00259	.00255	.00253	.00250
550	.00282	.00273	.00265	.00259	.00253	.00249	.00244	.00241	.00237	.00235	.00232
600	.00267	.00258	.00250	.00244	.00238	.00234	.00229	.00226	.00222	.00220	.00217
650	.00254	.00245	.00237	.00231	.00225	.00221	.00216	.00213	.00209	.00207	.00204
700	.00243	.00234	.00226	.00220	.00214	.00210	.00205	.00202	.00198	.00196	.00193
750	.00233	.00224	.00216	.00210	.00204	.00200	.00195	.00193	.00189	.00187	.00184
800	.00225	.00216	.00208	.00202	.00196	.00192	.00187	.00185	.00181	.00179	.00176
850	.00218	.00209	.00201	.00195	.00189	.00185	.00180	.00178	.00174	.00172	.00169
900	.00211	.00202	.00194	.00188	.00182	.00178	.00173	.00171	.00167	.00165	.00162
950	.00205	.00196	.00188	.00182	.00176	.00172	.00167	.00162	.00158	.00156	.00153
1000	.00200	.00191	.00183	.00177	.00171	.00167	.00162	.00159	.00155	.00153	.00150
1100	—	.00182	.00174	.00168	.00162	.00157	.00153	.00149	.00146	.00143	.00141
1200	—	—	.00167	.00160	.00155	.00150	.00146	.00142	.00139	.00136	.00133
1300	—	—	—	.00154	.00148	.00144	.00139	.00136	.00132	.00130	.00127
1400	—	—	—	—	.00143	.00138	.00134	.00130	.00127	.00124	.00121
1500	—	—	—	—	—	.00133	.00129	.00125	.00122	.00119	.00117
1600	—	—	—	—	—	—	.00125	.00121	.00118	.00115	.00112
1700	—	—	—	—	—	—	—	.00117	.00114	.00111	.00109
1800	—	—	—	—	—	—	—	—	.00111	.00108	.00105
1900	—	—	—	—	—	—	—	—	—	.00105	.00102
2000	—	—	—	—	—	—	—	—	—	—	.00100

where, $h'_i = h_i\ (A_o/A_i)$ and $h'_o = h_o\ (A_i/A_o)$ (7)

Thus, in any tubular transfer system the total thermal resistance (neglecting the resistance of the pipe wall) can be evaluated in terms of h_i and h_o if the pipe is large and thin-walled, or terms of h'_i and h'_o if the pipe is of small diameter or thick-walled.

The extended tables* which appear as part of this article permit direct solution for R or R_i or R_o where

*The tables are actually one table broken up for typographical reasons.

the required values of h_i, h'_i, h_o, or h'_o are known. In such a case the resultant R value is read directly from the table by entering at the known h_i or h'_i along the top of the table and moving vertically down to the line for the proper value of h_o or h'_o; the number read from the table is then the sum of the reciprocals of the two h values, hence is the combined thermal resistance of the two films. Values of h_i and h_o for many common refrigerants have been graphically evaluated in the sixteen articles of this series that have preceded this one.†

Example: A liquid is being heated within a pipe under conditions such that the inside film coefficient is 800 Btu per (hr) (sq ft) (°F). The fluid being cooled on the outside of the tube has a film coefficient of 425 Btu per (hr) (sq ft) (°F) and the tube has a ratio of inside diameter to outside diameter so close to unity that the difference between inside and outside surface areas can be neglected; the tube is thin walled and has negligible wall resistance to heat transfer. Determine the combined film resistance and the rate of heat transfer through 100 square feet of surface if the fluid-to-fluid temperature difference is 50F.

Solution: Enter the top of the table at $h_i = 800$ then move vertically down to the row for $h_o = 425$ where read the total thermal resistance as 0.0036. The rate of transfer, by equation 1 is therefore,

$q = 100 \times 50/(0.0036) = 1{,}390{,}000$ Btu per hour.

Example. For thermal conditions the same as those of the previous example determine the rate of heat transfer from 100 square feet of outside pipe surface if the ratio of outside-to-inside pipe diameter is as 10 to 9; the pipe wall is of high thermal conductivity and provides negligible thermal resistance.

Solution. The transfer rate is given by equation 1 with A taken as the outside area and R as given by equation 5; thus,

$$q = A_o(t_h - t_c)/[1/h_i(A_i/A_o) + 1/h_o]$$

But h_i is known as 800 and the area ratio is known as .9 hence the term $h_i(A_i/A_o)$ is equal $800 \times .9$ or 720. Entering the top of the table at 700 and the side at 425 read the corresponding resistance as 0.00378. Now enter the top at 750 and the side at 425 to read a total resistance of 0.00368. Interpolating between these two resistances the total resistance for h'_i of 720 and h_o of 425 is found to be $0.00378 - .2 \times .00010 = 0.00376$. The rate of heat transfer is therefore,

$q = 100 \times 50/0.00376 = 1{,}330{,}000$ Btu per hour

Comparison of the results from these two examples shows that the influence of a 10% difference between inside and outside surface areas is reflected (for the conditions of this particular example) in a change of less than 5% in the overall rate of heat transfer.

Summary. This article presents a table for determination of the total resistance, fluid-to-fluid, for heat transfer through a pipe or tube wall of negligible resistance. The table is applicable to either thick or thin-walled tubes providing only that the thermal resistance of the wall is small (as it almost always is) with respect to the film resistances.

The basic heat transfer equation is,

$$q = A(t_h - t_c)/R$$

where the A and R terms are as follows,

1. For thin-walled tubes of any diameter (the term thin-walled being approximately defined as corresponding to a tube for which the ratio of inside to outside diameter is greater than .9) the A value is for the outside surface and the R value is given by,

$$R = 1/h_i + 1/h_o$$

where R is read from the table for known values of h_i and h_o.

2. For thick-walled tubes of high thermal conductivity (wall resistance negligible compared with film resistances) the A value is best taken for outside surfaces area and the R value is then obtained from,

$$R = 1/h_i(A_i/A_o) + 1/h_o = 1/h'_i + 1/h_o$$

where R is read from the table for known values of h'_i and h_o.

3. For thick-walled tubes operating under conditions such that the wall-resistance is significant the table should not be used and the heat transfer rate should then be calculated by means of equation 2.

†These appeared under the title "Graphical Determination of Heat Transfer Film Coefficient for . . .", each covering a different refrigerant.

12 Billions Asked To Build Schools

A long-range program of school building expansion, calling for twelve billion dollars over the next twelve years, was proposed at the regional conference of the American Association of School Administrators.

Describing the shortage of school buildings as "critical," educators warned that the health and safety of hundreds of thousands of children were endangered because of inadequate classroom facilities. They proposed that this country spend a billion dollars annually until 1960 in order to "catch up" with the emergency.

Four thousand school officials, superintendents, teachers and college leaders, representing western education, attended the conference, associated with the National Education Association.

Because of the increased birth rate, school buildings are rapidly becoming overcrowded and entirely inadequate, the association noted. A 525-page report, "American School Buildings" warned that the expansion of buildings to provide space and facilities for all the children was a "must" facing the American people today.

Increased school costs, together with a continued shortage of critical materials and an all-time high for labor, have combined to handicap the building program. The report found that large numbers of pupils were attending schools that were unsafe and outdated; that others were in buildings which had long since outlived their educational usefulness. Many of the schools were built long before the Civil War.

(Above) A sidewalk snow-melting system goes to work on a 4-in. snowfall as hot water and anti-freeze flow through embedded pipe. Picture above right was taken 40 minutes later than picture above left. The snow-melting installation is at the Protane Gas Service Co., Erie, Pa. The system consists of a gas water heater and lengths of 1-in. pipe spaced a foot apart. All photos on this page are from A. M. Byers Co.

Four Snow-Melting Systems

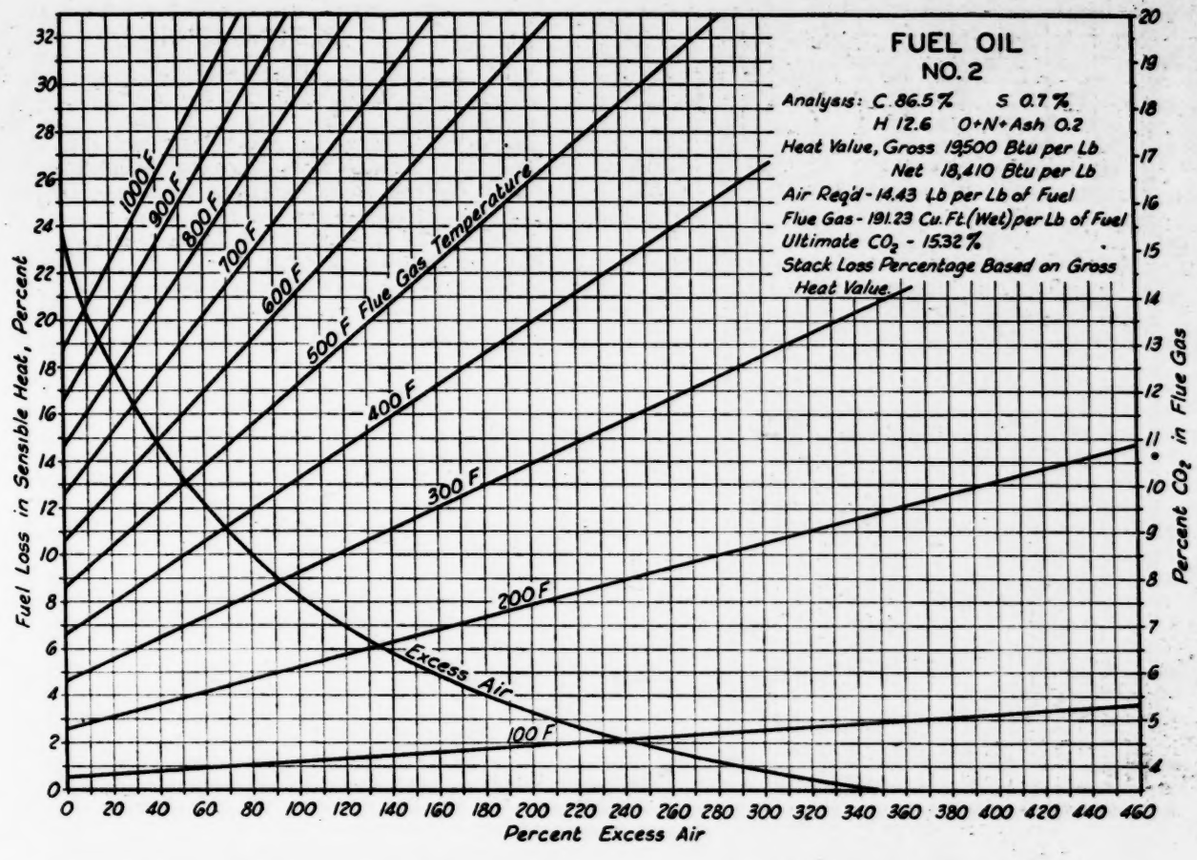
(Left) Said to be the first hotel in the country to use embedded heating pipes to keep sidewalks free from ice and snow is the Lafayette Hotel, Clinton, Iowa. Heating coils are grids of 1¼-in. pipe on 24-in. centers with supply and return headers along the sides of the walk. Steam at less than 10 lb pressure is supplied from the hotel boiler through a header pipe adjacent to the building. It flows through the grid and into a return line near the curb. System was installed by the Domestic Plumbing Co., Clinton, Iowa.

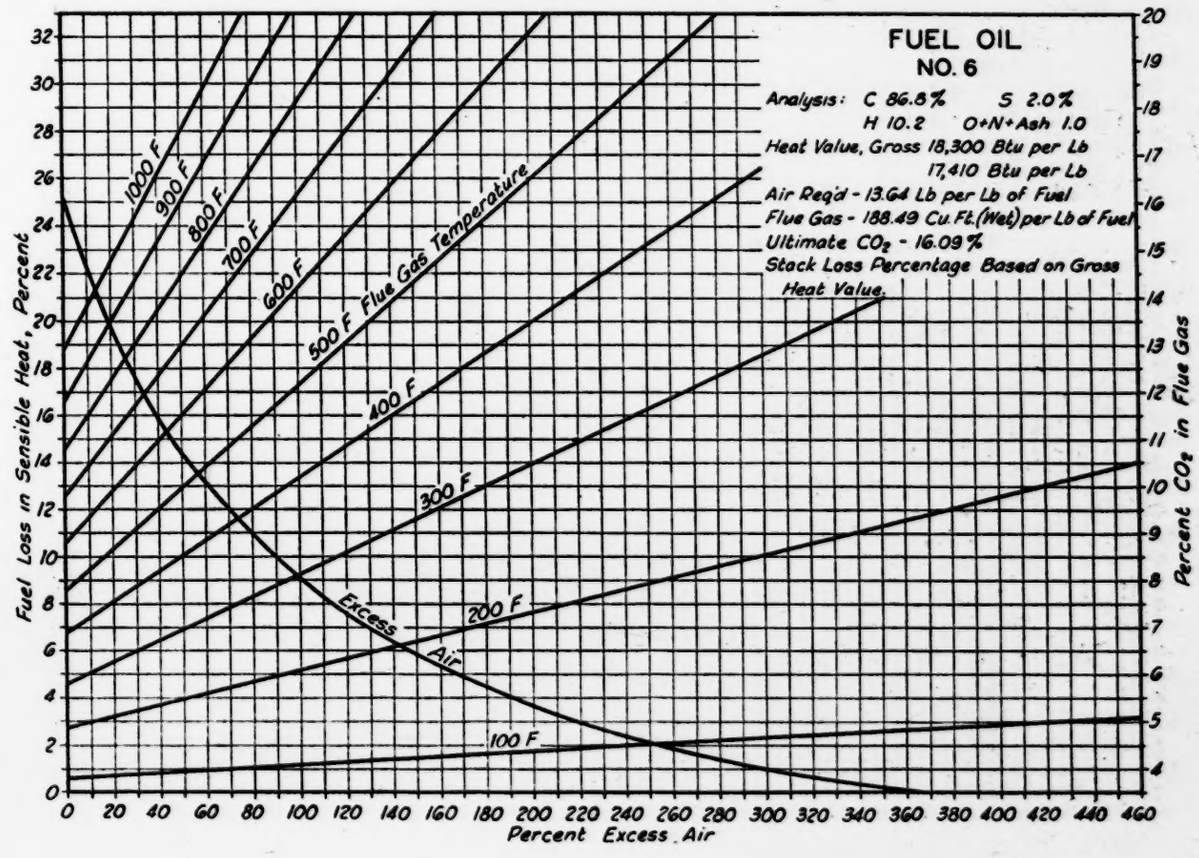
(Left) The first snow-melting system designed to keep hangar doors free from ice and snow is installed at Chicago for American Airlines. Nearly two miles of 2-in. and 2½-in. pipe keep clear a strip 7 ft wide and 415 ft long under doors across full width of the hangar. System circulates hot water from a boiler in the hangar.

(Below) Dr. H. S. Krakauer of Boston, New York, keeps his driveway clear of ice and snow by turning up a small gas-fired heater in the garage. Hot water is pumped from the heater through sinuous coils of 1¼-in. pipe embedded in the driveway.

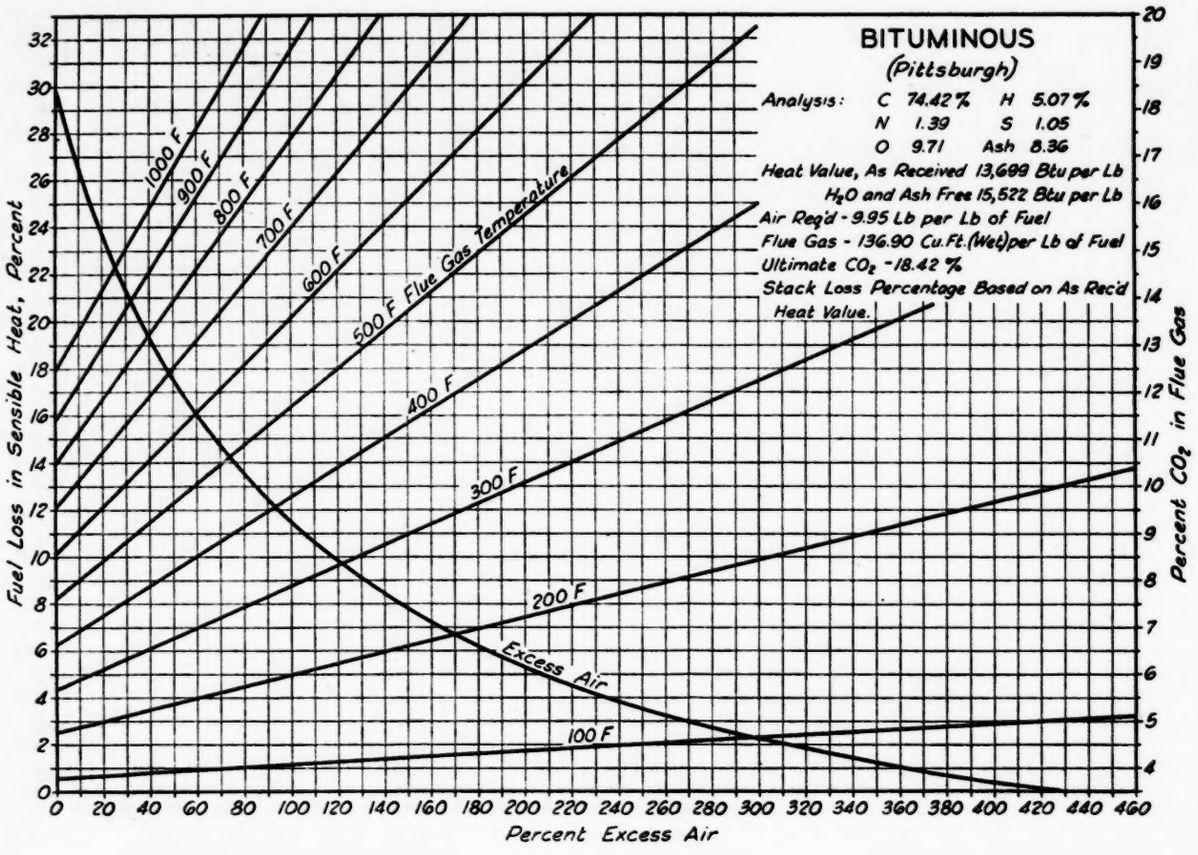
Bind in

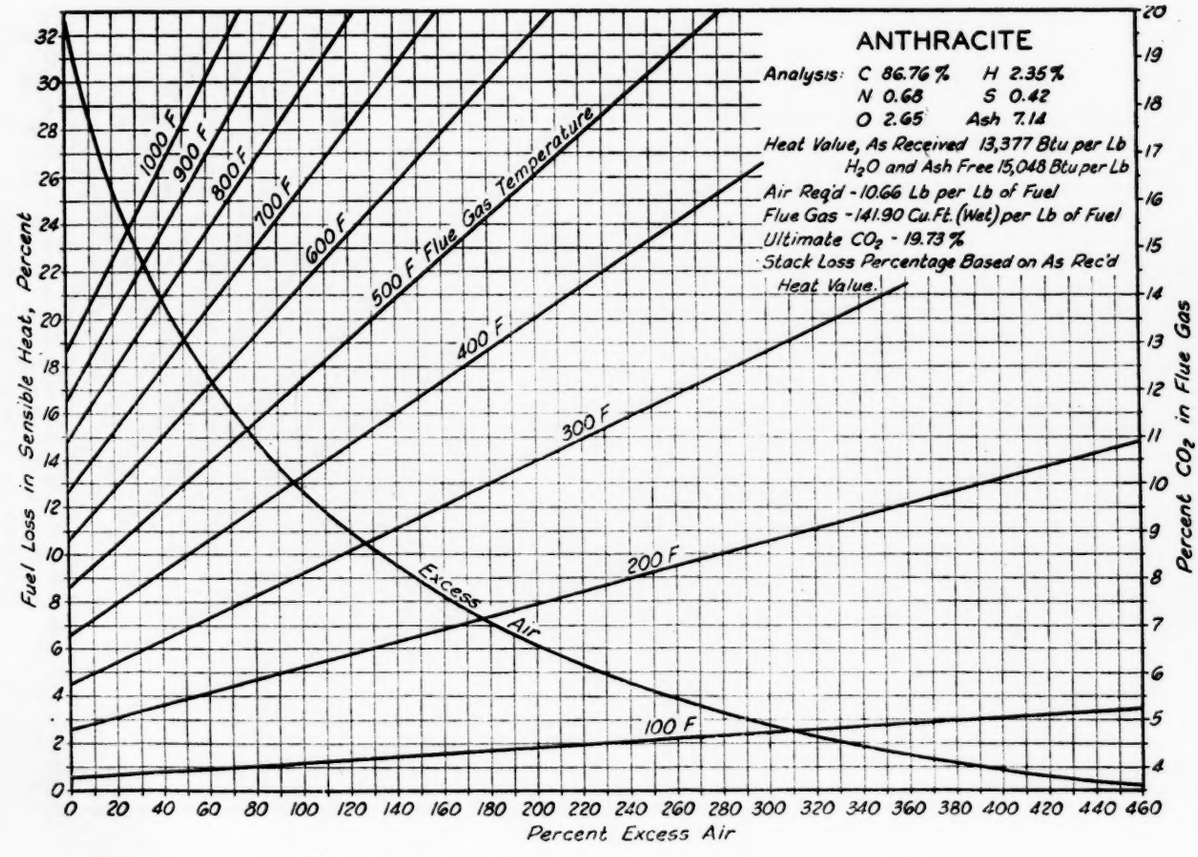
SENSIBLE HEAT LOSS IN FLUE GAS – FUEL OIL


FUEL OIL
NO. 2
Analysis: C 86.5% S 0.7%
H 12.6 O+N+Ash 0.2
Heat Value, Gross 19,500 Btu per Lb
Net 18,410 Btu per Lb
Air Req'd - 14.43 Lb per Lb of Fuel
Flue Gas - 191.23 Cu. Ft. (Wet) per Lb of Fuel
Ultimate CO_2 - 15.32%
Stack Loss Percentage Based on Gross Heat Value
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
Excess Air
100 F
Fuel Loss in Sensible Heat, Percent
Percent CO_2 in Flue Gas
Percent Excess Air

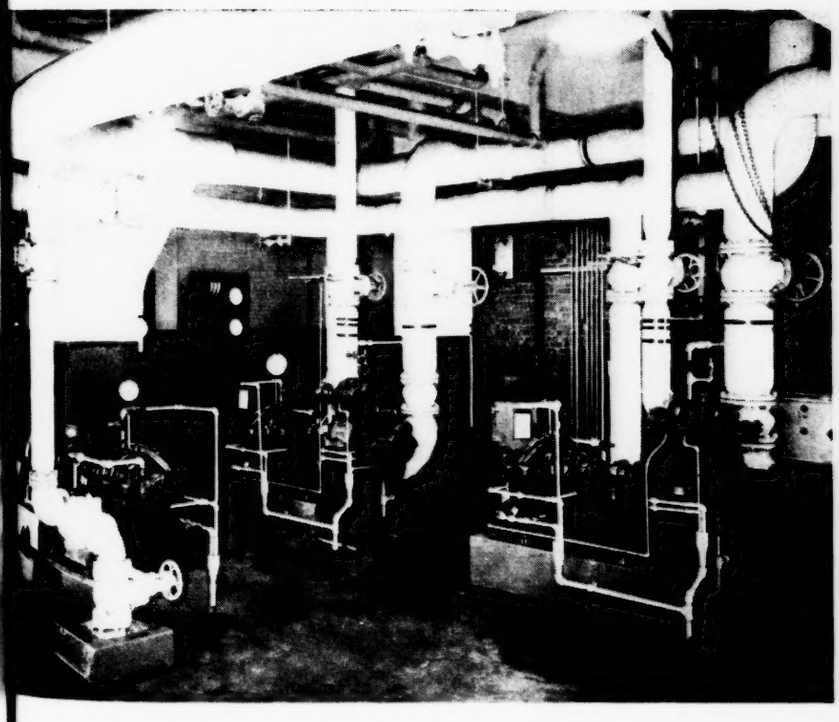

FUEL OIL
NO. 6
Analysis: C 86.8% S 2.0%
H 10.2 O+N+Ash 1.0
Heat Value, Gross 18,300 Btu per Lb
17,410 Btu per Lb
Air Req'd - 13.64 Lb per Lb of Fuel
Flue Gas - 188.49 Cu. Ft. (Wet) per Lb of Fuel
Ultimate CO_2 - 16.09%
Stack Loss Percentage Based on Gross Heat Value
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
Excess Air
100 F
Fuel Loss in Sensible Heat, Percent
Percent CO_2 in Flue Gas
Percent Excess Air

HEAT LOSS IN FLUE GAS – PITTSBURGH BITUMINOUS AND ANTHRACITE


BITUMINOUS
(Pittsburgh)
Analysis: C 74.42% H 5.07%
N 1.39 S 1.05
O 9.71 Ash 8.36
Heat Value, As Received 13,699 Btu per Lb
H2O and Ash Free 15,522 Btu per Lb
Air Req'd - 9.95 Lb per Lb of Fuel
Flue Gas - 136.90 Cu.Ft.(Wet) per Lb of Fuel
Ultimate CO2 - 18.42 %
Stack Loss Percentage Based on As Rec'd Heat Value.
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
100 F
Excess Air
Fuel Loss in Sensible Heat, Percent
Percent CO2 in Flue Gas
Percent Excess Air


ANTHRACITE
Analysis: C 86.76% H 2.35%
N 0.68 S 0.42
O 2.65 Ash 7.14
Heat Value, As Received 13,377 Btu per Lb
H2O and Ash Free 15,048 Btu per Lb
Air Req'd - 10.66 Lb per Lb of Fuel
Flue Gas - 141.90 Cu.Ft.(Wet) per Lb of Fuel
Ultimate CO2 - 19.73 %
Stack Loss Percentage Based on As Rec'd Heat Value.
1000 F
900 F
800 F
700 F
600 F
500 F Flue Gas Temperature
400 F
300 F
200 F
100 F
Excess Air
Fuel Loss in Sensible Heat, Percent
Percent CO2 in Flue Gas
Percent Excess Air

Check Valves IN PIPING



14 Different Swing and Lift Check Valves Described, with Explanation of Where and How to Use Each One

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Manager, Alloy Sales, Crane Co.
Chicago

Check Valves In Piping

14 Different Swing and Lift Check Valves Described with Explanation of Where and How to Use Each One.

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Check valves, designed to permit flow in one direction only, may be the most important valves in a system. Mr. Bartlett offers data for selection and maintenance of check valves as a guide to specifiers.

FEW engineers appreciate the real importance of check valves in a piping system, or the severity of the service to which they are exposed. Check valves —valves designed to permit flow in one direction only, and to close automatically if flow reverses,—are entirely automatic in action, depending solely upon pressure and velocity of flow within the line to perform their functions of opening and closing.

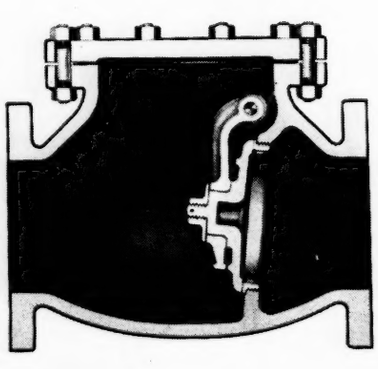
Whenever a check valve is really needed in a line, it is just about the most important valve in the entire job; it is distinctly a "safety first" valve. It is used either to prevent dangerous back flow in a line, or, in the case of two or more fluids being supplied to a common point at different pressures and different temperatures, to prevent one fluid from backing up into another line.

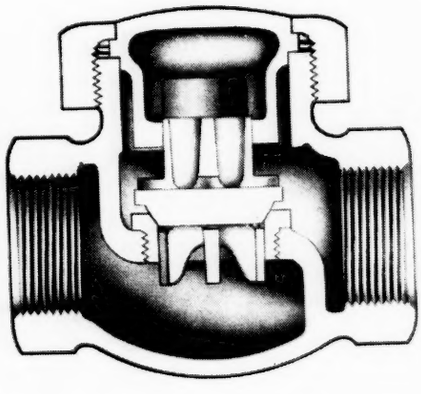
Manually operated gate or globe valves could be used to control direction of flow, but instead check valves are used in order to obtain quicker, automatic action and extreme sensitiveness to changes in flow conditions. Thus, a check valve is expected to do more than the gate or globe valve, but it is seldom indeed that users of valves put a fraction of the thought on the selection of the check valve that they do on the gate or globe valve.

The fact that check valves are automatic in action renders proper selection even more important. General experience indicates clearly that most automatic valves are subject to great abuse through the tendency of operators to rely on the automatic features performing without any attention. Since the disc of a check valve in normal service moves with every fluctuation in flow and pressure, it follows that the moving parts of such a valve are subjected to much more severe wear than occurs in a manually-operated valve. In the average check valve, this movement of the disc is not limited or cushioned from one end of its travel to the other, so that where severe pulsations of flow take place, "slamming" of the disc at both extremes occurs. The destructive effect set up is far more severe than anything which occurs in a normal manually-operated valve under the same conditions. These factors must be kept in mind if even reasonable good service is to be obtained from these important valves.

Two Basic Types

There are only two basic types of check valves—the swing check (Fig. 1) and the lift check (Fig. 2). In the straight swing check design, flow through the body is approximately the same as through a gate valve. A bridge wall, against which the disc seats, is transposed across the line of flow, and the disc is hinged to a pin placed crosswise of the body above the bridge wall. The disc is free to swing in an arc about this hinge pin, the lower limit of its travel being the bridge wall and the upper limit some point on the body or cap far enough removed from the bridge wall to insure that full flow will take place through the valve when the





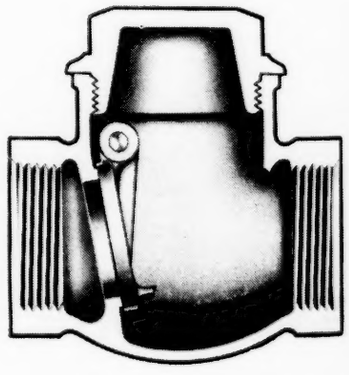


Fig. 1. (Left) Swing check valve. Fig. 2 (Center) Lift check valve. Fig. 3. (Right) Straight-way check valve with one-piece disc and hinge.

disc is in the wide open position. The angle of the bridge wall and the relationship in position between the hinge pin and the seat is such that, with no pressure or flow through the valve, the disc is held to the seat by gravity.

The lift type check valve is also known as the horizontal, and sometimes as the globe type. In this design, bodies of exactly the same design as regular globe and angle valves are commonly used. The disc is free to move in a straight line at right angles to the bridge wall and seating surface. To insure proper seating, the disc is equipped with guides above or below the seat or both. Guides and disc are integral so that this type of check valve has a minimum number of moving parts. These valves are always installed so that the force of gravity holds the disc to its seat when there is no flow through the valve.

Swing Check Valves

In the general family of swing check valves, there are a number of designs which merit some individual consideration, such as, (1) common straight-way with metal disc, (2) common straight-way with regrindable disc, (3) straight-way with composition or leather disc, (4) angle type, (5) common foot valve, and (6) straight-way with outside lever and weight.

1. Common Straight-way Check with Metal Disc. All of this type have bridge walls with an inclination from the vertical of approximately 10 degrees. In this respect they differ materially from the regrinding type, in which the inclination of the bridge wall is 45 degrees. There has been so much discussion about proper angles of bridge walls in some quarters that a brief survey of the factors involved will be given.

Since all swing check valves must be installed with the force of gravity tending to hold the disc to the seat, it is obvious that if the bridge wall were exactly vertical (in other words, having zero degrees inclination), the force holding the disc to the seat with no flow through the valve would be a minimum. Conversely, the force required to start raising the disc from its seat is also a minimum. To many users, this would seem to be the ideal condition, on the theory that loss in head through the valve would be kept to the lowest possible amount. Actually, such construction is impractical, because the small excess amount of power available to hold the disc to the seat renders the disc so sensitive to pulsations in flow that pounding and leakage is bound to occur. As a consequence, standard practice has been to increase the angle of inclination of the seat to about 10 degrees, at which position there is sufficient gravitational force present in the disc assembly to insure tight seating even on very low pressures. The increased angle of inclination has no appreciable effect on the frictional resistance to flow through the body and thus a well balanced design is achieved.

Some check valves of this type have a one-piece disc and hinge construction (Fig. 3). This reduces the number of internal parts to a minimum, but also introduces a problem of alignment between disc and seat. There is no flexibility in the hinge-disc unit and, therefore, if the hinge becomes bent through pounding or if slight body distortion takes place from any one of a number of causes, the valve is bound to leak since the disc cannot find its seat. Replacement of the hinge-disc unit in these valves is also something of a problem since great care must be exercised to insure that the seating surfaces are in proper alignment.

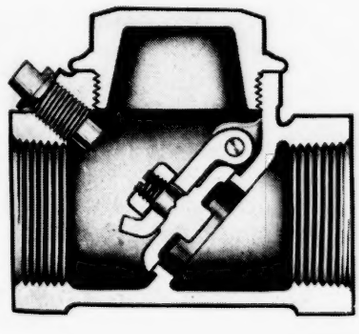


Fig. 4. Straight-way check valve with regrindable disc.

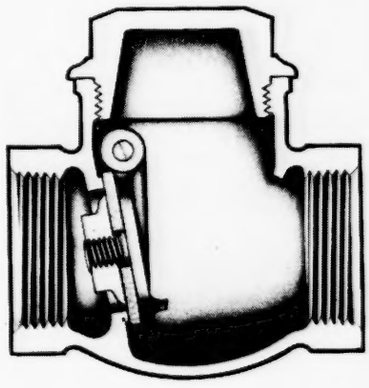


Fig. 5. Straight-way check valve with leather disc.

2. Common Straight-way Check with Regrindable Disc. Theoretically, any check valve with a swivel type metal disc can be reground. The term "regrinding," however, is applied only to those valves in which provision is made for regrinding the disc while the valve is in the line.

These valves (see Fig. 4) have bridge walls inclined at 45 degrees from the vertical, a much greater angle than employed in any other type of swing check valve. In this case, the angle is chosen to provide a minimum overall length of body and yet allow for the provision of an opening in the body through which a tool can be inserted to revolve the disc on its seat.

The resistance to flow in valves of this type is greater than in those having a more nearly vertical bridge, but this apparent disadvantage is more than compensated for by the ease with which the seating surfaces may be kept in good condition.

3. Straight-way Check with Composition or Leather Disc. These valves (Fig. 5) are all similar in general construction to regular metal disc valves of the same type, but leather disc valves are intended solely for cold water service. When temperature is not a factor there is a definite advantage in using soft disc valves particularly for services where foreign matter may be present in the fluid being handled. On low pressures and low differentials of pressure, the slightest particle

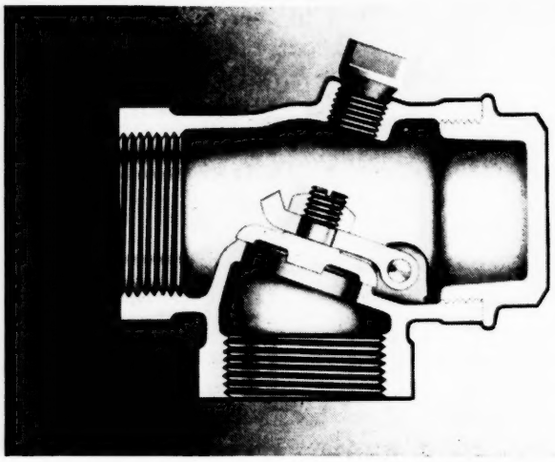


Fig. 6. Angle type check valve.

of dirt on the seat of a metal disc check valve will hold of disc off the seat and cause leakage. With a soft disc this possibility is greatly reduced.

Making use of standard composition discs and disc holders of the conventional type insures that repairs can be quickly and easily made, and at a lower cost than for leather disc valves. As in all composition disc valves, the seat is protected at the expense of the disc which results in lower maintenance cost and greater life for the valve.

4. Angle Type Swing Check. The angle type check valve (Fig. 6) is a variant of the swing check intended for use where the flow is to change direction 90 degrees. They save space where this change of direction is involved and also save a mitre or elbow.

5. Common Foot Valves. These have leather discs seating on the bridge wall, but the leather of the disc is extended beyond the seating surface to form an integral hinge which is anchored to the bridge wall. In effect, these are "flap" valves but they operate exactly the same as swing check valves in that the disc swings through an arc. These valves are extremely simple in design, have a minimum number of parts, have no metal-to-metal contacts anywhere in their operating mechanisms, and give excellent service on dirty, gritty water. They cannot be used on hot water or on any fluid which will harden or attack leather.

6. Straight-way Swing Check with Outside Lever and Weight. This introduces the subject of special features as applied to ordinary swing check valves.

In this design (Fig. 7) the hinge pin is rigidly attached to the hinge and rotates as the disc swings, the external level moving through the same arc. The lever and weight can be applied in either of two positions —to assist the disc in closing, thereby making the valve extremely sensitive to reversal in flow, or to balance the disc, causing the valve to open under a minimum of pressure. The first construction is probably the commoner, and is widely used when it is desired to have the valve close promptly when forward flow ceases and before reversal can take place. This construction increases the pressure drop through the valve and adds to the load on the pump.

The second construction is employed when valves are used on extremely low pressures, and particularly where valves are large, involving a very considerable amount of weight in the disc and hinge. Balancing the weight of disc and hinge results in easier operation and a lower pressure drop through the valve.

Lift Check Valves

Most lift check valves are definitely companion valves to globe and angle valves of the same pressure classification, while swing checks are much more individualistic, as far as details of construction are concerned. Thus, for lift checks, the following classification will be used: (1) straight globe type with metal disc, (2) straight globe type with composition disc, (3) angle type, (4) vertical type, (5) common foot valve, (6) ball type, (7) cushioned type, and (8) the stop-check.

1. Straight Globe Type with Metal Disc. This classification (Fig. 8) covers all metal disc valves, both with and without renewable seats. Valves in this group are of the same general regrinding type, but there is a great variation in individual details of construction. Take the matter of caps, for instance; there are screwed caps, union caps and bolted caps, depending on whether the basic globe valve had a screwed bonnet, a union bonnet, or a bolted bonnet.

A similar variation in design of guides for the discs can be found. Thus, some valves have wing guides above and below the disc, others have center post guides above and below the disc, one with wing guides above the disc only, and still others with center post guides above the disc only. All of these methods of guiding discs conform to standard practice and in themselves alone are not sufficiently important to warrant acceptance or rejection of a valve. Accuracy of guiding is far more important than type of guiding.

As pointed out in discussing swing check valves, the power available to seat the disc in any check valve is frequently very low. This means that unless perfect contact is had between the seat and disc, leakage is bound to result. In lift check valves, the disc and its guides are one solid unit with no flexibility anywhere. In the regrinding type, beveled seating surfaces are used, which require that the disc be brought to the seat without cocking or tilting. Real accuracy in guiding is essential in order to insure tightness of seating surfaces under these conditions. Liberal area of guiding surfaces is an additional necessity if accuracy is to be maintained, for wear is accentuated in check valves due to the constant, and sometimes violent, movement of the discs.

2. Straight Globe Checks with Composition Discs. These are similar to the group just discussed (Fig. 9) except that composition discs are used in place of regrindable metal discs. The merits of composition disc check valves have been rather completely discussed in the section on composition disc swing check valves. Briefly, for low pressures and on low differentials of pressure, it is easier to keep seating surfaces tight when soft discs are used than when metal discs are employed. On liquids containing dirt or foreign matter, such valves offer a real advantage. Likewise on low pressure air, or gases and fluids which are hard to

hold, composition discs are usually considered to provide tighter seating surfaces than metal discs.

3. Angle Type Lift Valve. The same comments apply as to the angle type swing check valves.

4. Vertical Check Valves. This group (Fig. 10) is the first type of lift check valve so far considered which is distinctive in body design. They are designed exclusively for upward flow, a service in which they meet competition from swing check valves. They differ from swing checks in that the discs move in a straight line parallel to the flow, and are guided above and below the seats. The bridge wall containing the seating surfaces is interposed across the line of flow and at right angles to the long axis of the body.

Two different body designs are commonly used, one having the body made in two halves parted just above the bridge wall, while the other has a one-piece body with access to the interior being had through a bolted cap on the side. The difference in construction is due to the difference in size of the two types of valves, it being impractical to use removable caps in the smaller sizes.

5. Common Foot Valves. This follows closely after vertical lift check valves because essentially they are exactly the same (see Fig. 11). In considering foot valves in general, it should be borne in mind that they are intended only for low pressure service, since their purpose is merely to keep the suction pipe to a pump full in order to eliminate hand priming of the pump. To accomplish this purpose, absolute tightness of seating surfaces is essential. For that reason, valves with soft discs are usually given the preference.

Construction of foot valves in general is quite light, as they are only intended to withstand a maximum head of 34 feet, corresponding to about 15 pounds pressure. When centrifugal pumps are used discharging against high heads, foot valves of this type should be avoided, for there is always the possibility of flow reversing when the pump is shut off, thus building up a pressure far beyond the capacity of these valves to withstand. Use swing check valves if high pressures are likely to occur.

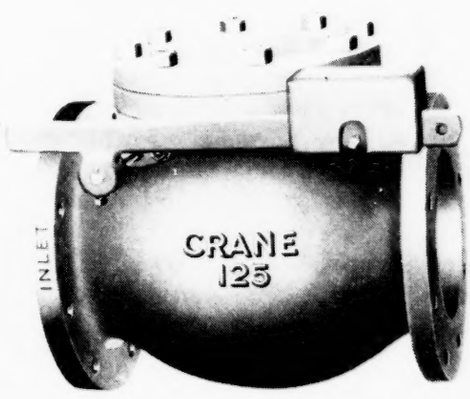
6. Ball Check Valves. This is a type of lift check in which a spherical ball is substituted for the conventional guided disc (see Fig. 12). The principal advantage claimed for this design is that the ball never seats in the same place twice as it has a tendency to turn due to the action of the fluid passing through the valve. This action tends to keep the seat clean. Likewise, the contact between the ball and its guides is very limited and the possibility of sticking is reduced thereby.

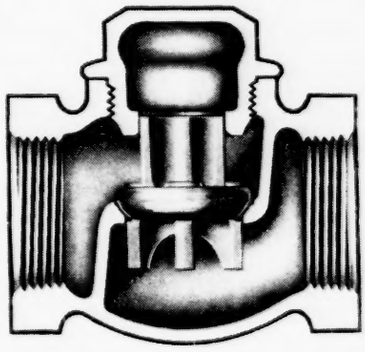
To assure tight valves it is necessary that the ball be absolutely perfect in contour so that regardless of how much the ball turns it will always present a perfectly true surface to the seat.

These valves resemble vertical check valves in general design, having bodies made in two halves, but because the ball is free to roll on its guides they can be used in the horizontal position as well as in the vertical. Conventional vertical check valves with flat guided discs cannot be used in the horizontal position because of the danger of sticking. Advancement in the art of manufacturing large size balls of extreme accuracy has been responsible for the development of satisfactory check valves of the ball type. In oil refinery service, where fluids are likely to leave gummy or coke-like deposits in valves, the ball check design has acquired considerable popularity because of its apparently better performance.

7. Cushioned Check Valves. These valves are worthy of special consideration; they are all of the lift type (see Fig. 13). The upper part of the disc forms a piston operating in an accurately machined cylinder which may be an integral part of the body or a separate liner. The piston and cylinder forms an effective dashpot, which cushions the movement of the discs on both the opening and closing stroke and eliminates slamming and pounding.

For severely pulsating flow, the valves with friction rings are recommended because their cushioning effect is more pronounced than in valves with plain pistons. The latter are suitable where pulsations are only moderate in intensity or intermittent. Whenever trouble is being experienced with ordinary types of check valves going to pieces, it is well to remember that cushioned valves are available in a wide range of sizes. In general they have a slightly greater resistance to flow than ordinary lift checks, and their first cost is considerably higher. On the other hand, they will indefinitely withstand severe service conditions under which any other type of valve will not last an even reasonable length of time.





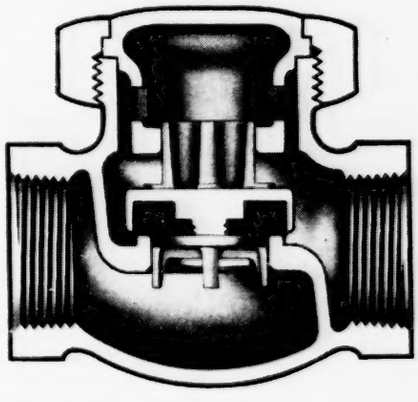
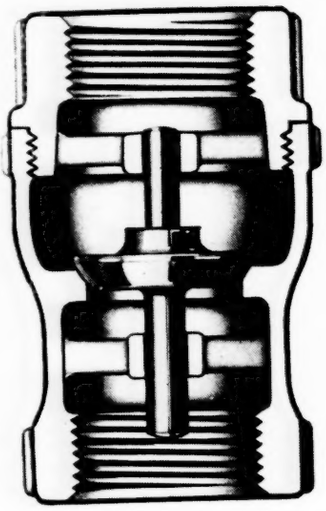


Fig. 7. (Left) Swing check valve with outside lever and weight. Fig. 8. (Center) Globe type check valve with metal disc. Fig. 9. (Right) Globe type check valve with composition disc.



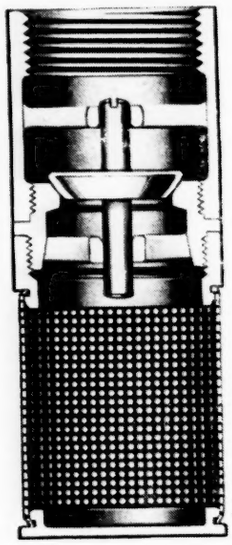


Fig. 10. (Left) Vertical check valve. Fig. 11. (Right) Foot valve with strainer.

8. Stop-Check Valves. This classification is a type of lift check in which external mechanical means are provided for seating the disc and holding it closed. (Fig. 14). In all of these valves, a threaded stem is used which has no mechanical connection with the disc. When the stem is screwed to the upper limit of its travel, the valve acts as an ordinary lift check valve since the stem then does not influence the movement of the disc. When screwed down to the other extreme of its travel, the stem engages the disc and forces it to its seat, and the valve then acts as a positive stop valve. By adjusting the stem to some intermediate point in its travel, the upward movement of the disc may be limited and the normal flow through the valve itself controlled. Upon reversal of flow, of course, the valve will still act as a check valve.

Screw-down check valves in general appearance are identical with globe valves, the essential difference being that the disc is not attached to the stem. It is common practice to have the lower end of the stem machined to a sliding fit with a hole bored in the disc so that when the stem is in the open position, the disc can slide up and down on the stem which acts as a guide for it. For boiler feed service or any installation where pulsations in flow may be severe, it is considered advisable to insert a spring between the disc and the bonnet in order to prevent slamming of the disc which might result in battering the end of the stem.

Stop-check valves were primarily designed for service on the steam leads from boilers to headers, but they can be used for many other purposes. Their design, as far as cushioning the movement of the disc is concerned, is superior to that of any other check valve, and in addition they have many other desirable features.

All moving parts operate in a removable liner which contains the seat, so that the entire mechanism can be renewed without taking the valve out of the line. The liner prevents expansion strains and distortion from being transmitted to the internal parts and thus eliminates binding and cramping which frequently interfere with the free action of ordinary valves. The disc has a long throttling lip which insures that the disc will not strike the seat even on pulsating or low flow, for flow does not start through the valve until the disc is a considerable distance above the seat. Pounding, chattering and wire-drawing is thus reduced to a minimum. The disc is the only moving part in these valves, and its simple cylindrical shape provides ample guiding surface with a minimum tendency toward spinning which might cause rapid wear. When it is desired to eliminate the stop feature, a plain flanged cap can be furnished in place of the bonnet, yoke and stem.

Installation of Check Valves

There are certain simple fundamental rules which must be followed in installing check valves if proper service is to be received by the user.

Since check valves have no external moving parts which indicate direction of movement of the discs, it is relatively easy to install them backwards if care is not used. This is particularly true of globe type lift checks which have symmetrical bodies with no visual indication of the position of the bridge wall or the disc. On swing checks, the location of the hinge pin is indicated by the position of the external hinge pin plug, so that only a glance is needed to tell which way the disc swings.

The basic rule covering the installation of all check valves is that they must be applied so that the force of gravity tends to close the valve. The only exception to this rule is the case of the high pressure vertical type ball check valves which may be used in the horizontal position. Following this rule through, it will be seen that swing check valves can be used in horizontal lines and also for upward flow in any line inclined at any angle up to 90 degrees from the horizontal. Lift check valves of the globe type, on the other hand, should only be used in horizontal lines although theoretically they could be used in lines inclined at angles up to 45 degrees from the horizontal. Practically, play in the guides of the ordinary type of globe check valves is sufficient to cause improper seating of the disc if the movement of the disc is varied from a vertical line.

Swing check valves, regardless of the angle of the pipe line in which they are used, should always be installed with the hinge pins in a horizontal position. Since the disc swings in an arc whose plane is at right angles to the axis of the hinge pin, this insures that the disc will always swing in a vertical plane. There is sufficient play in the component parts of the hinge-disc assembly in swing checks to render imperfect seating likely if the valve is canted over to one side when installed. Wear in the hinge pin and its bearings accentuates this condition and, therefore, in installing or checking the performance of these valves, always be sure that they are properly aligned.

The same remarks as far as alignment is concerned apply to lift check valves. They should always be applied to a pipe line in such a way that the movement of the discs is in a vertical plane. This is particularly true of lift check valves with metal discs, for here beveled seating surfaces are used which require that

the discs be brought to the seats without canting or cocking if tight seating is expected.

Where to Apply Check Valves

The manufacture of so many individual lines of check valves has had the effect of confusing many users as to what types of valves are best suited for various services. Basically, there are only two distinct types—the swing check and the lift check.

Two questions immediately confront us when the subject of check valves comes up:

(1) Where should swing check valves be used?

(2) Where should lift check valves be used?

Two Simple Rules. Two very broad rules have been in quite general use for many years to cover these questions. The first is, "When gate valves are required in a line, use swing check valves with them. When globe valves are used, use lift checks." The other is, "On liquid service, use swing check valves. On steam, air, gas or general vapor service, use lift checks." There is considerable merit in both of these rules, although it is immediately evident that there is some conflict between them and there are quite a few exceptions to both. The two rules in a sense are corollaries to each other and, judiciously used, point out a sound policy of application.

It is obvious, of course, that the first rule is not very definite, for there is no general rule covering the usage of either gate or globe valves, and so we frequently find them used indiscriminately on steam, air, oil, water and gas. In a general sense, however, it is true that gate valves predominate for liquid service, because liquids flow under low head pressures, or power is expended to pump them, and velocities are usually quite low. As a consequence, losses due to friction are important and extra precautions are taken to insure minimum resistance. For such service, gate valves have a definite advantage, and swing check valves fall into the same category, for their resistance to flow is much less than that of lift check valves. Furthermore, since the velocities are low in liquid lines, the destructive effect of "slamming" which ruins most swing check valves, is greatly reduced.

Some notable exceptions can be made to the rule that swing checks should be used on liquid lines. For example, when there are several pulsations in flow such as caused by reciprocating pumps, it is desirable to use cushioned check valves. No swing check can be adequately cushioned, hence it is necessary to recommend lift check valves of the proper design. Again, in the handling of volatile liquids or those which are notably hard to hold, difficulty will likely be had with swing check valves, for they are not as tight as lift check valves, and not as easy to keep in good condition.

Applying Swing Check Valves. Disregarding exceptions, it can be assumed that the greatest field of usefulness for swing check valves is in water and other liquid service. Considering very briefly the six sub groups of swing checks, the following six comments can be made.

(1) Check valves with the integral disc-hinge construction can be used on hot or cold water service and on steam at very low pressures, as in heating systems. Their use should be avoided where severe wear on the seating surfaces may take place, because of the difficulty of making repairs. They should never be used on rapidly pulsating flow.

(2) Check valves of the regrinding type can be used on hot or cold water and on other fluids not corrosive to iron or brass. Like all swing check valves, they should not be used on pulsating flow. For steam service at all save low pressures, lift checks are preferred.

(3) Leather disc valves are recommended specifically for cold water service especially when foreign matter is present.

(4) Angle swing check valves are space and material savers, and where direction of flow is suitable can be used for the same conditions as regular swing check valves.

(5) Foot valves for cold water or other cold liquids should be of the leather disc type, providing such other liquids are not destructive to leather. Where centrifugal pumps discharging aganist high head pressures are used, it is preferable to use a leather disc swing check valve in place of a regular foot valve.

(6) Weighted swing check valves have two very definite applications, as previously pointed out. The first is on the discharge side of centrifugal pumps operating against high heads where it is desirable to have the valve close when the pump stops and before reversal in flow can take place. For this service the weight is applied to help close the disc. The second

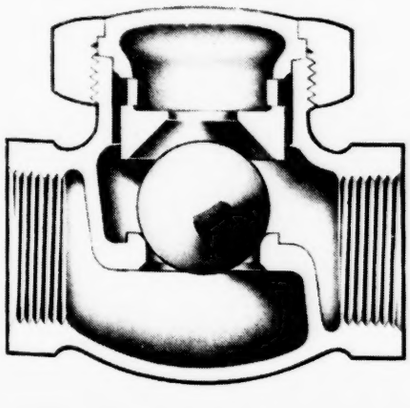


Fig. 12. Ball check valve.

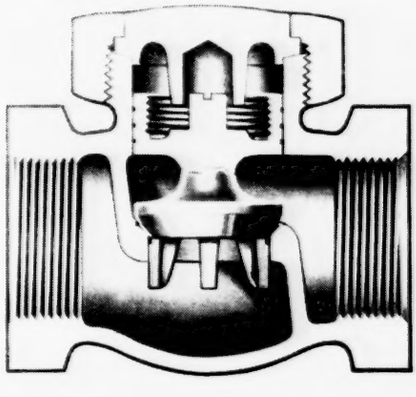


Fig. 13. Cushioned check valve.

Fig. 14. Stop-check valve.

case is where large valves are used on low water or gas pressures, for which service installing an outside lever and weight to balance the disc results in easier operation and a smaller pressure drop through the valve.

Lift Check

Applying Lift Check Valves. Lift check valves are definitely considered to be superior to swing check valves for service on steam, air, gas, and vapors in general. The deciding factors which influence choice in this case are that gases are usually much harder to hold than liquids and the velocities used are much higher. No shop difficulties are experienced in making lift check valves tight on such service, but swing checks offer a much more serious problem. Regrinding type swing checks can be made to pass an air test in the shop after special lapping, but a few operations usually cause them to leak again. Attention has already been directed to the fact that the slamming of the disc in a swing check valve at both extremes of its movement is highly destructure, and this action is intensified as velocities increase. Ordinary velocities in steam, air, and vapor lines are, at least, twenty times as great as in liquid lines. Knowing that even in liquid lines swing checks sometimes pound themselves to pieces, it is easy to imagine what happens to them when the velocities are so enormously increased.

Summarizing general service recommendations for all lift check valves of the eight subgroups already listed, the following five comments can be made.

(1) All metal disc lift check valves of the globe, angle, and vertical types are suitable for use on steam, air, gas, and general vapor service, providing there *are no severe pulsations* in flow. Valves for air and gas should be specially ground and tested. All of these valves may be used on hot or cold liquid service, providing low resistance to flow is not a major objective.

(2) Composition disc lift check valves may be used on the same classes of service as metal disc valves and with the same limitations as far as pulsations are concerned. For low pressure air service, valves with soft discs are better than any metal disc valves and should be recommended. For extremely low air or vapor pressures, soft disc valves with a spring above the disc to aid in closing and maintaining tight seating surfaces, should be recommended. Air service in general is hard on check valves and it is advisable, therefore, to use sturdy valves. On liquids, which are hard to hold, composition disc valves with suitable discs will stay tight longer than metal disc valves.

(3) Ball type lift check valves are frequently used on service where gummy deposits are liable to form on guides and seats to such an extent that the ordinary type of valve might not operate properly.

(4) Cushioned type lift check valves should be used on steam, air, gas, and all liquid service where severe pulsations in flow are present.

(5) Stop-check valves are essentially cushioned check valves and have the same general field of application, although they were primarily designed for boiler lead service.

Stop-Check Functions

Applying Stop-check Valves. Of all the check valves so far discussed, probably only the stop-check has been given wide publicity through advertising and sales literature. These valves were designed specifically for one important service, namely in steam lines between boilers and headers, although it has already been pointed out that they perform admirably in many other locations in piping systems. Boiler lead service is so important, however, that particular attention should be given to them for that class of work. To start with, an automatic stop-check valve should be installed in the pipe line from each boiler to the main steam header, when more than one boiler is connected to the same header. When so used, the valve performs four important functions:

(1) It acts as an automatic non-return valve, preventing a back flow of steam from the header into the boiler in the event of a failure in the boiler.

(2) It acts as a manually operated stop-valve which may be closed when it is necessary to cut a boiler out of service temporarily without drawing the fire. A gate valve is usually installed at the header so that the line may be shut down when it is necessary to work on the stop-check valve.

(3) It automatically cuts the boiler into service when pressure has been built up to a point slightly above the header pressure, and conversely prevents it from going into service if it is not steaming properly to carry its share of the load. Thus, it gives immediate evidence of improper boiler operation.

(4) It acts as a "safety first" valve to prevent a back flow of steam from the header into a boiler which has been shut down for inspection or repair.

Joints to Permit Movement

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Part 3 of a three-part article covering the type joints available for expansion or contraction of a pipe line. This section deals with swing, swivel and ball joints, rotary pressure and locomotive piping joints.

IN Fig. 35*a* and 35*b* are shown common methods for taking care of expansion and contraction in a building heating or hot water riser, and the movement at the base of the riser due to expansion of the main. Screwed fittings are so arranged that expansion and contraction of the riser or main will cause the screwed fittings to swivel on the nipples to which they are attached. Five elbows are used on the riser and four of these can swivel on the horizontal nipples *a* and *b* with any expansion or contraction of the riser.

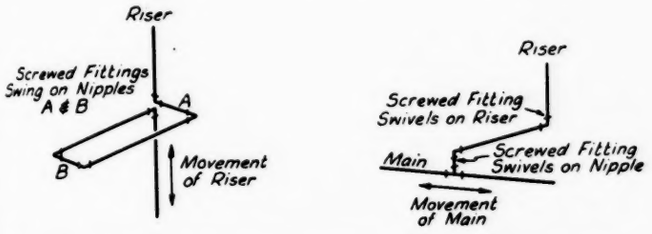


Fig. 35a and 35b. Common methods for permitting expansion and contraction in a heating or hot water riser.

Two screwed elbows are required at the connection from a main or horizontal branch to a riser and these swivel on the vertical nipple and the base of the riser, if there is any longitudinal movement of the main due to expansion or contraction.

Where connections to tanks, tank cars, barges, docks, loading and unloading racks or other apparatus to which permanently fixed connections cannot be made, are required, swing, swivel or ball joints may be desirable.

A single swing joint that is recommended for gasoline service is shown in Fig. 36. This joint has the following very desirable features:

(1) A shoulder is provided on the inner end of the sleeve which engages with the end piece of the body and prevents the sleeve from pulling out when in service.

(2) The load on the sleeve is carried back to the body itself and does not rest on the packing.

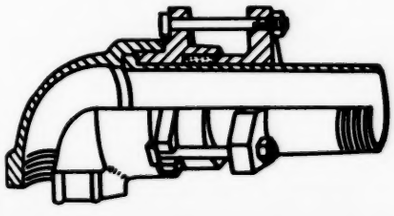


Fig. 36. Single swing joint.

(3) An extra deep stuffing box with three-bolt gland is provided as insurance of leak-free service.

A double swing joint of this type is also available.

The swing joint, Fig. 37, consists of a body and a hollow ell-shaped plug which is held into the body by a nut and washer. Both body and plug are tapped with iron pipe size connections. The joint operates in a manner similar to an ordinary plug cock, both body and plug being carefully ground together to insure maximum ease of operation. Ports in the plug

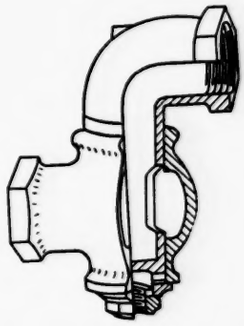
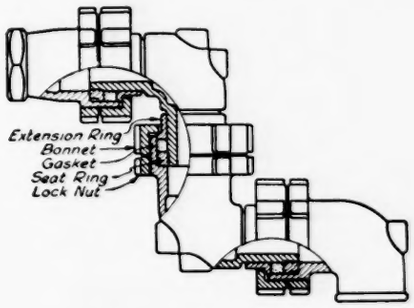


Fig. 37. Swing joint which operates similar to a plug cock.

and the passageway in the body are so designed that free flow of the fluid being handled is insured, and there is no restriction of port areas regardless of the angle at which the plug is turned. No packing is used in these joints. All parts of these swing joints are made of brass to eliminate any possibility of corrosion causing the plugs to bind.

Swing Joints for Locomotive Piping

The swing joint shown in Fig. 38*a* is used extensively for locomotive swing joint connections on water supply, steam heating, air brake and air signal piping.



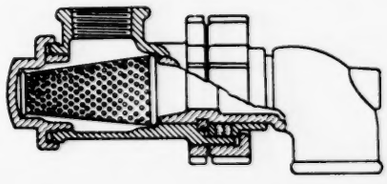


Fig. 38a, upper. Joint for locomotive swing joint connection. Fig. 38b, lower. Swing joint in the form of a tee, provided with a strainer.

This joint consists of two fittings, one of which has a belled end which is threaded on the outside to receive a screwed bonnet piece and a lock nut, and counterbored at the bottom of the bell to provide a recess for a split ring. The other fitting is extended to form a sleeve piece which fits into the body of the

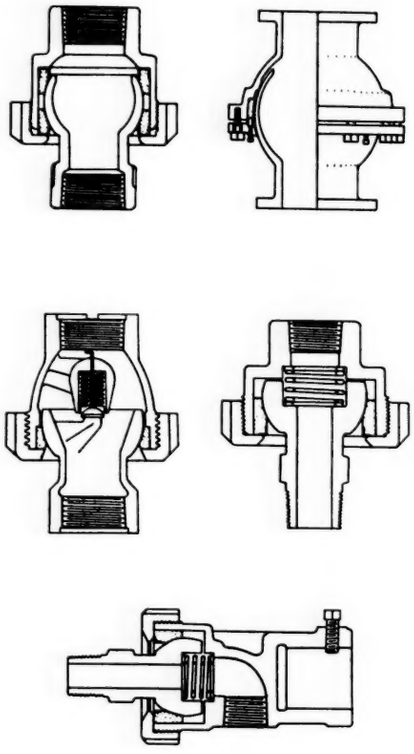


Fig. 39. Upper left, a, ball type joint with screw connections. Upper right, b, ball type joint with flange connections. Center left, c, an improved form of a. Center right, d, spring seated, swivel type ball joint. Lower, e, joint for use on pressing machines.

first piece. A groove having a depth of one-half the thickness of the ring is turned in the sleeve to receive the split ring.

A brass ring, packing, and an extension ring are held in place above the split ring and in the bell end of the body fitting by means of a screwed bonnet.

After the screwed bonnet has been tightened sufficiently to make a joint which can swivel but is tight against leakage, the lock nut can be tightened to prevent movement of the bonnet.

The body piece can be made in the form of a tee and equipped with a strainer if required for water lines, as shown in Fig. 38*b*, or in the form of an elbow with an automatic drain valve for use on steam lines.

A ball type joint with screwed connections is shown in Fig. 39*a* and one with flanged connections is shown in Fig. 39*b*. Flexible ball joints provide for a substantial angular movement and, in addition, can be swiveled through an angle of 360 degrees. They are tight seating and may be used on steam, water, oil, air, gasoline, tar and other similar fluids. Sizes 3 in. and smaller are recommended for 300 lb steam working pressure and sizes 4 in. to 6 in. for 125 lb steam pressure.

The screwed type of ball joint has two sets of packings, one of which is held in place by the ball-shaped end and the other is held by a gland and large nut.

The flanged type has a machined guide surface on the inside and a packing which is held in place by a follower flange which is adjusted by means of bolts.

Fig. 39*c* is an improved form of the joint shown in Fig. 39*a*. In this joint, a single gasket only is used and a spring support is provided at exactly the center of the ball so that the ball receives the maximum amount of pressure to hold it against the gasket with the minimum amount of friction and resistance to angular movement which it is possible to obtain. The spring is shrouded so that it has considerable protection against the corrosion and erosion of the fluids passing through the joint, and in addition to this protection, it is made of stainless steel.

A swivel type ball joint, which is spring seated, is shown in Fig. 39*d*. This type of joint is especially suitable for use where the pressure fluctuates or when the temperature varies as when steam and cold water are used alternately. It has a malleable iron casing, a bronze ball end, a stainless steel spring, a hard nonmetallic gasket, and is suitable for services up to 300 lb steam working pressure.

A special form of this type of joint for use on pressing machines is shown in Fig. 39*e*.

Rotary Pressure Joints

Calenders and corrugators in the paper industry; slashers, dry cans, sanforizers and calenders in the textile industry; rubber mills; flat work ironers; milk drying machines; cold strip mills for the steel industry and numerous other items of similar equipment require that steam, cold water or brine be constantly supplied under pressure to rotating cylinders. Where steam is to be supplied to such equipment it is also necessary to provide for the removal of condensate.

For some equipment such as calenders, it is also necessary to make provision for mounting joints and arranging piping in such manner that sudden changes in the lateral alignment of the rolls will not affect the joints.

In Fig. 40 is shown the basic design and construction of a rotary pressure joint that is widely used for this type of service. The rotating member consists primarily of two parts: The nipple *A* which is attached to the rotating roll or drum, and the thrust collar *B* which slides freely endwise over the nipple, but is keyed to it by the key *C* so that the entire assembly rotates as a unit. Both of these parts have convex, hemispherical ends, as shown, which rotate against the matching concave surfaces of two special carbon graphite rings *D* and *E*. The spring *F* maintains an initial seating pressure against these two rings, but as later explained, the actual sealing force is the pressure within the joint. The ring *D* acts as a pressure seal. As pressure increases within the joint, the spherical nipple is forced against this seal ring, in

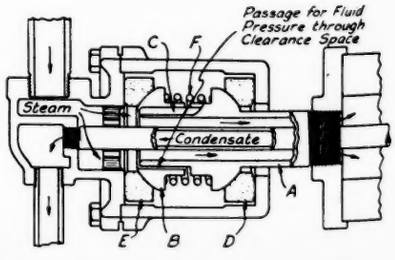


Fig. 40. Basic construction of a rotary pressure joint.

this way making the joint self-adjusting. The use of this seal ring also entirely eliminates packing. The ring *E* acts as a bearing for the thrust collar. Since both the thrust bearing ring *E* and the seal ring *D* are made of a special carbon graphite having self-lubricating properties, oiling is totally eliminated.

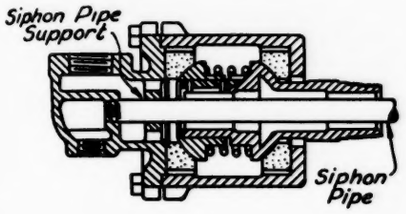
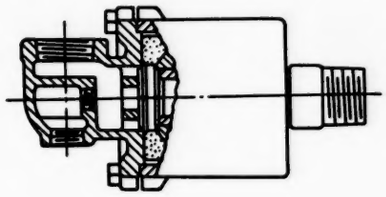


Fig. 41. Design which permits lateral roll movement in addition to ball and socket flexibility.



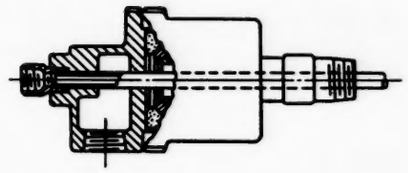


Fig. 42a, upper, and b, lower. Arrangements of steam and condensate connections for a siphon type joint.

The spherical or ball and socket form of the rotating member provides angular flexibility; an annular space between the seal ring and housing (also between the nipple and opening) provides the highly essential lateral flexibility.

This joint has the following desirable features:

Adaptability to all machines; it is self-adjusting; packless; nonbinding; requires no oiling; flexible in all directions; gives longer service life and low maintenance costs.

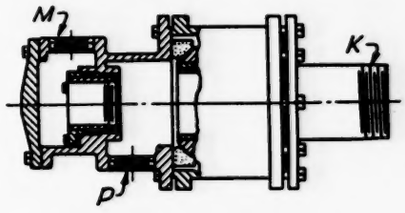
The angular flexibility of this joint due to the ball and socket type of construction is obvious, but the lateral roll movement permitted by the design is of even greater importance. This feature is best explained by reference to Fig. 41 which shows a joint with the nipple perfectly centered in relation to the joint body and the siphon pipe.

It is not always possible to install a rotary joint so perfectly on a pipe that its relation to the roll will not be affected by expansion and contraction of the piping as well as by bearing wear.

As previously explained, the outside diameter of the carbon graphite rings is less than the inside diameter of the housing, and there is also an annular space between the nipple and the opening in the housing. The space thus provided permits lateral movement of the entire internal mechanism. Whether the mechanism is moved up or down the nipple remains in a position parallel to the siphon pipe.

It is this lateral movement that reduces the wearing through the siphon pipe that often takes place in rotary pressure joints. The lateral movement feature permits the seal rings to adjust themselves. This is an important factor in the ability of the joint to seal tightly and to function satisfactorily.

The importance of the pressure seal feature is very evident. As shown in Fig. 40, fluid under pressure has free passage through the clearance space between the nipple and thrust collar, and therefore surrounds the rotating member, forcing the spherical end of the nipple against the seal ring, and the seal ring against the end of the housing. In this way the seal is increased as the pressure increases. The freedom of rings and other wearing parts to find seats, the self-lubricating effect, etc., combine to produce a self-adjusting condition with minimum of friction and freedom from binding.



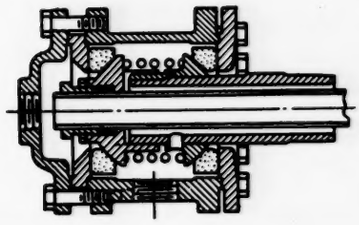


Fig. 44, upper. Rotary pressure joint. Fig. 45. lower. Joint for use with dipper drained dryers.

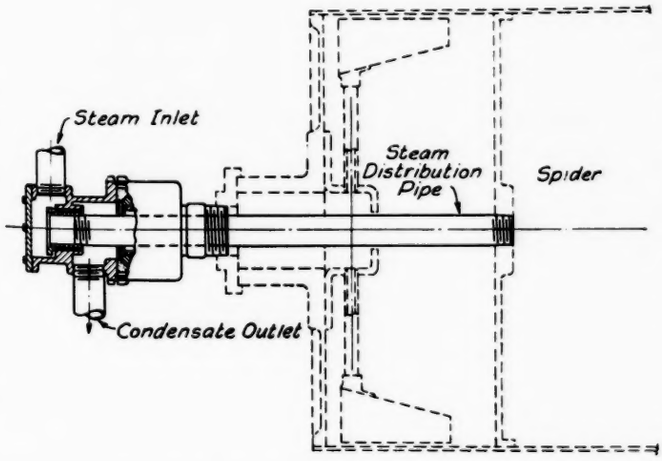


Fig. 43. Joint for rotary steam distribution.

The carbon graphite composition of the seal and thrust bearings eliminates the necessity for oiling.

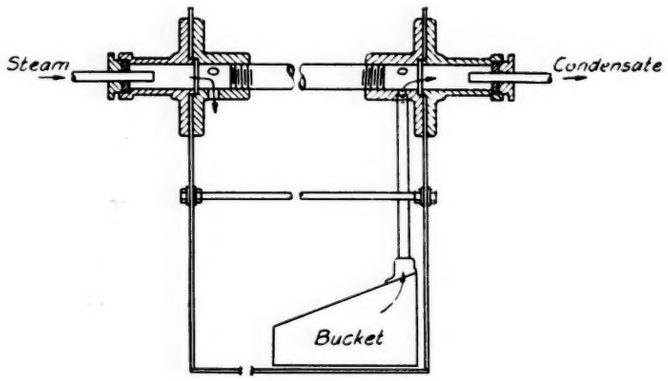
The only major wearing contact is between the rotating member and the carbon graphite rings. As these surfaces soon become polished to mirror smoothness and are constantly self-lubricating, wear is reduced to a minimum. It is confined to the carbon graphite rings which may be easily and economically replaced.

When a siphon pipe is used for removal of condensate, it is installed with the straight end screwed tightly into the steam inlet fitting. The other end is curved and extends down to within an inch or so of the bot-

tom of the cylinder. The condensate is forced out through the siphon pipe by the steam pressure in the cylinder at a much faster rate than is possible by gravity flow with bucket drainage and consequently a lower condensate level can be carried. The siphon pipe is securely supported by a bridge or spider which relieves the thread in the joint head from carrying the full weight of the pipe.

The arrangement of the steam and condensate connections for a siphon type joint may be varied as shown in Fig. 42*a* and 42*b*.

When rotating dippers are provided for removal of condensate as shown in Fig. 43, a rotary pressure



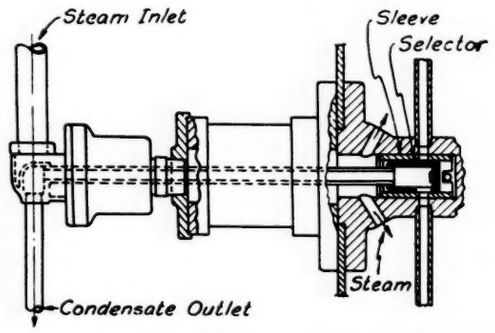


Fig. 46, upper. Tie rods prevent use of single stationary siphon pipe. Fig. 47, lower. Special unit with rotating siphon pipes.

joint as shown in Fig. 44 may be used. The steam distribution pipe which is screwed into the spider inside the drum has a screwed-on sleeve at the other end which rotates with the sleeve pipe in a bearing provided with several rings of packing and an adjustable gland to provide a tight joint between the sleeve and the bearing. Steam enters at *M* as shown in the large scale detail, Fig. 44, and passes through the rotary steam distribution pipe to the drum. The condensate is picked up by the rotating buckets as they reach their lowest position and is discharged when they are in their highest position through a connecting pipe to a chamber on the axis of the drum and from there through the large nipple *K* to outlet *P* on the head piece.

The joint shown in Fig. 45 is also designed for use with dipper drained dryers and differs from the joint

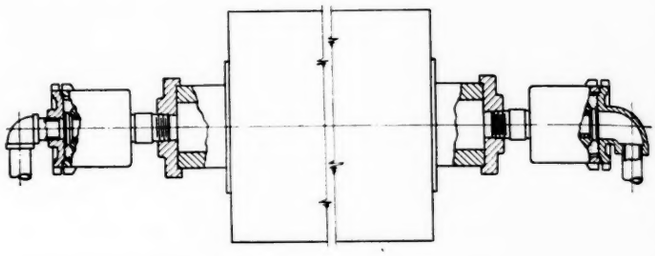


Fig. 49. Joint for use with water or brine.

shown in Fig. 44 in that the steam distribution pipe is supported in the special joint thrust collar. This design makes the steam distribution pipe integral with the joint nipple and it therefore is not affected by movement or deflection in the joint head. The packing gland seals the incoming steam from the outgoing condensate and also permits longitudinal movement of the steam distribution pipe.

Because of tie rods or supports in most large cylinders as shown in Fig. 46, the single stationary siphon pipe cannot be used, but a special unit with rotating siphon pipes as shown in Fig. 47 is available. The operating principle of this unit may best be understood by reference to Fig. 48.

Instead of a single stationary siphon pipe, several siphon pipes are fastened to a special flange inside the cylinder. The flange and multiple siphon pipes revolve with the cylinder. In the center of the flange is a siphon pipe selector connected to the condensate pipe leading out through the joint. The selector, which remains stationary, has an opening at the bottom which registers successively with each hole in the flange into which the siphon pipes are screwed, as the pipes reach their lowest position. When the siphon pipe registers with the selector, the lower end is submerged in condensate which is forced out through the pipe and thence through the joint.

When the pipe passes out of register with the selector, the next pipe comes into register and thus an intermittent flow of condensate passes out of the roll through the joint.

The joints shown in Fig. 49 are used where water or brine is to be supplied at one end of a roll and removed at the other.

Installation Suggestions

It is important when making the piping connections to avoid any pipe strain which crowds the joint toward the roll. Fig. 50 illustrates what happens when crowding occurs.

The strain compresses the spring, allowing the steam or liquid to escape by the openings *A* and *B* and then the nipple opening.

From this it will be seen that it is important that the piping be flexible enough to compensate for seal

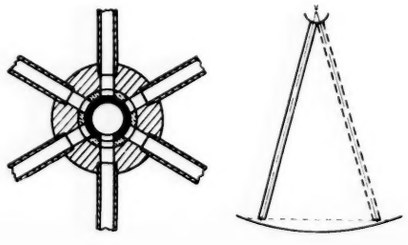


Fig. 48. Operating principle of rotating siphon.

ring wear and at the same time be sufficiently rigid to hold the joints in a concentric position.

The use of three elbows in the steam piping provides sufficient flexibility to permit the joints to move and

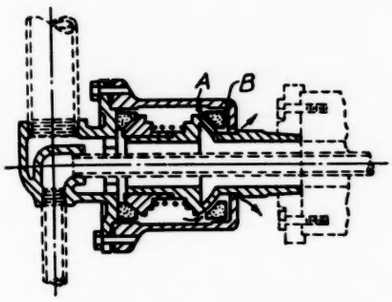
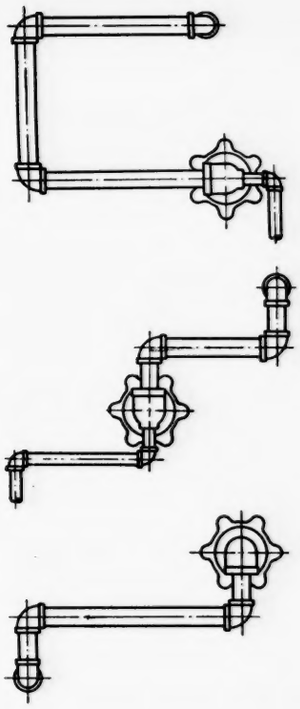


Fig. 50. To show what happens when pipe strains crowd the joint.

compensate for seal ring wear. Fig. 51 shows arrangements of piping using three elbows that have proved very successful.

Fig. 51. Arrangements of piping using three elbows to provide flexibility and movement.



References

For further information on this subject, the reader should consult the following catalogs and bulletins:

Catalog No. 52—Crane Co., 8365 Michigan Ave., Chicago, Ill.

Corrugated Type Expansion Joints—E. B. Badger & Sons Co., Boston, Mass.

Packless Copper Expansion Joints—Joseph Kopperman & Sons, 310-316 New St., Philadelphia 6, Pa.

Packless Expansion Joints—Cook Electric Co., Chicago, Ill.

C M H Expansion Joints—Chicago Metal Hose Corp., Maywood, Ill.

Rubber Expansion Joints—U. S. Rubber Co., Rockefeller Center, New York 20, N. Y.

Rubber Expansion Joints—B. F. Goodrich Co., Akron, Ohio.

Barco Flexible Ball Joints—Barco Manufacturing Co., 1801 Winnemac Ave., Chicago, Ill.

Bardo Swing Joints—L. J. Bardo Co., Glenside Pa.

Sliding Expansion Joints—American District Steam Co., Tonawanda, N. Y.

Rotary Pressure Joints—The Johnson Co., Three Rivers, Mich.

This concludes the series of articles on pipe joints that started in the September, 1947, issue of HEATING AND VENTILATING.

Controlled Air Diffusion in Electronics Plant

Every modern facility which could contribute to its manufacturing operations was considered in the new electronics plant at Allentown, Pa., built by the Western Electric Co., manufacturing unit of the Bell System. This industrial structure, erected by the Austin Co. of Cleveland, is specially designed for the manufacture of vacuum tubes, and precision electronic equipment. Air conditioning and air distribution are of particular importance in this type of manufacture.

To create the ideal environment for its critical precision processes, over 500 specially designed and adjusted and strategically located air diffusers are served by about four miles of air ducts. These diffusers feed some 750,000 cfm of chilled or tempered air into the various areas in such a way as to induce and mix with this primary air up to 7,000,000 cfm of room air, depending upon the season of the year. The diffusers in the main floor of the manufacturing building are further designed to return a controlled volume of air to the overhead plenum for reconditioning and recirculation or exhaust. Particularly unique in this respect are the specially designed diffusers serving the central area of this main floor because, in order to satisfy the prescribed balance, the air supplied to the peripheral areas must flow toward the center area. This required the 208 diffusers in the central area to extract from it approximately 30% more air than they supply to it.

The outer cone of these central diffusers has an outside diameter of 45 in., or almost 4 ft. The supply neck is 27 in. O.D., and the return neck 19⅞ in. O.D., with supply and return areas of 1.82 sq ft and 2.15 sq ft, respectively. It is believed that this is the first time that a combination supply and return air diffuser has been designed with greater return than supply air capacity.

Each diffuser is equipped with a special built-in damper to provide for variation in air delivery from 25% below to 25% above the normal requirement, without affecting the diffusion pattern.

The W. B. Connor Engineering Corp. cooperated with engineers of Western Electric, Associated Factory Mutual Fire Insurance Co., and the Austin Co. in adapting Kno-Draft diffusers to requirements of this plant.

Air Conditioning, Refrigeration, Heating and Ventilating

Courses Offered by Colleges

NATHAN N. WOLPERT
Associate Editor, Heating and Ventilating

TO provide a current list of the courses in heating, ventilating, air conditioning and refrigeration that are available at the various universities and engineering colleges in the United States, a survey was undertaken by HEATING AND VENTILATING to collect the necessary information.

Letters were sent to registrars of the various colleges, and where no reply was received, a second letter was mailed requesting a school catalogue from which to obtain the necessary information. From a few colleges the necessary data could not be obtained to be included in this tabulation.

In most cases the specialized engineering courses are given either in the senior year or are available as a graduate elective. Where a course is listed as being an elective, unless otherwise noted, it refers to those students registered in the Department of Mechanical Engineering.

California Institute of Technology, San Luis Obispo, Calif., has a four-year course leading to a degree of B. S. in Refrigeration and Air Conditioning Engineering. At a few colleges, the undergraduate has a senior option which provides for specialization in the heating, ventilating, air conditioning and refrigeration fields. At some schools work in heating and air conditioning is considered a senior requirement.

If instruction is available through an evening extension course, such information is designated. For example, Pratt Institute, Brooklyn, N. Y., offers a planned four-year evening course in air conditioning for which a certificate is granted. Rutgers University, New Brunswick, N. J., has a three-year evening course in air conditioning for which a diploma is granted.

In the tabulation, under Credit Hours, *Q* after a number indicates that the school term is divided into quarters and the credits are quarter credits. Unless so noted, the school year consists of semesters. A single credit may be taken to represent one hour of lecture and a prescribed amount of outside preparation, or it may represent an equivalent amount of laboratory work.

Requests for additional information about specific courses should be addressed to the college concerned at the address listed.

Correspondence Courses

Courses in the Principles of Mechanical Refrigeration; Refrigerating Engineering; Air Conditioning; and Heating, Ventilating and Air Conditioning are offered by The Pennsylvania State College, State College, Pa., through correspondence.

Courses in air conditioning, heating and ventilating; and refrigeration are available at the University of Minnesota, Minneapolis, Minn.

Correspondence courses are also offered by:
Rutgers University, New Brunswick, N. J.
Oklahoma Agricultural and Mechanical College, Stillwater, Okla.
University of Wisconsin, Madison, Wis.

It is possible that instruction through correspondence is also provided by other colleges.

Table on the following three pages will be concluded in the April issue.

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Alabama						
Auburn	Alabama Polytechnic Institute	Refrigeration	1Q	5	Thermodynamics	Senior requirement
		Air Conditioning		5Q	Refrigeration; Heat. and Vent.	Senior elective
		Heat. and Ventilation		5Q	Thermodynamics	Senior elective
University	University of Alabama	Refrigeration		5Q	Thermodynamics	Elective
		Heat. and A.C.		3Q		
Arizona						
Tucson	Univ. of Arizona	Air Conditioning			Thermodynamics	Elective
California						
Berkeley	University of California	Reversed Thermo. Cycles and Refrig.	1	3	Thermodynamics	
		Industrial A.C.	2	3	Thermodynamics	
		Refrigeration and General A.C.	1	3	Thermodynamics	
		Refrigeration				15-session extension courses given when in demand
		Air Conditioning				
Los Angeles	Univ. of Southern California	Heating and Ventilating		3	Thermo.; Fluid Mechanics and Heat Transfer	Senior elective
		Refrigeration and A.C.		3	Thermo.; Fluid Mechanics and Heat Transfer	Senior elective
Pasadena	Calif. Inst. of Tech.	Refrigeration and A.C.	1 & 2Q	4	Heat Power	Graduate elective
San Lius Abispo	Calif. State Polytechnic College	A.C.; Refrigeration; Heating; Ventilating				Included in 4 yr. course leading to B.S. in Refrig. and A.C. Eng.
		A.C.; Refrigeration; Heating; Ventilating				Covered in 3 yr. course for Refrigeration and A.C. certificate
Colorado						
Boulder	University of Colorado	Heating and Ventilation		3Q	Physics; Dynamics	For architectural students
		Air Conditioning	2Q	3	Heat Transfer	Senior elective
		A.C. Design	3Q	4	Air Conditioning	Senior elective
		Refrigeration	2Q	4	Thermo.	Senior elective
		Advanced A.C.	1Q	3		For graduate students
Connecticut						
Storrs	Univ. of Conn.	A.C. and Refrigeration		3	Power Plants; Heat Transfer	
Delaware						
Dover	Univ. of Delaware	Heating and Ventilation				Required course
District of Columbia	The Catholic Univ. of America	A.C. and Refrigeration	2	2	Mech. Equipment of Bldgs.	Senior requirement
	The Geo. Washington Univ.	Heating, Ventilating, A.C. and Refrigeration	1 & 2	4	Thermodynamics	Senior requirement. Also available as evening course
Florida						
Gainesville	University of Florida	Refrigeration and A.C.		3	Thermodynamics	Senior elective
		Advanced A.C.		3	Thermodynamics	Graduate course
		Mechanical Laboratory		1	Refrigeration and A.C.	Senior elective
Georgia						
Atlanta	Georgia School of Technology	Heating, Ventilating, A.C., Refrigeration				3 yr. evening certificate course
		A.C. and Refrigeration		2	Mech. Equipment of Bldgs.	
		Design of Mechanical Equip. of Bldgs.		2	A.C. and Refrigeration	
		Heating, Ventilation and A.C.		3	Thermodynamics	Senior elective
		Refrigeration		3	Thermodynamics	Senior elective
Idaho						
Moscow	University of Idaho	Heating, Ventilating Refrig. and A.C.	2	3		Senior course

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating—Continued

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Illinois						
Chicago	Illinois Institute of Technology	Advanced A.C.	1	4		Graduate course
		Fundamentals of Heating and A.C.			Algebra and Physics	Evening course
		Heating and A.C.		3		Evening course
		Refrig. Engineering		3	Thermodynamics	Senior elective
		Heating and A.C.		3	Thermodynamics	Required of seniors
		A.C. Analysis		4	Thermo.; Heating and A.C.	Senior elective
Evanston	Northwestern University	Heating and A.C.	2Q	3	Heat Power Fundamentals	Senior requirement
		Advanced Refrigeration		4	Thermodynamics	Senior elective
Urbana	University of Illinois	Heating, Ventilating and A.C.	1 or 2	4	Thermo. and Mechanical Eng. Laboratory	Senior course
		Refrig. Engineering	1 or 2	3	Thermodynamics	Elective
		Mechanical Equipment of Bldgs.	1 or 2	1	Senior standing	Laboratory elective
Indiana						
Lafayette	Purdue University	Heating, Ventilating and A.C.	1	3	Thermodynamics	Senior elective
		Commercial Heating, Ventilating and A.C.	2	3	Heating, Ventilating and A.C.	Senior elective
		Heating, Ventilating and A.C. Design	2	3	Heating, Ventilating and A.C.	Senior elective
		Refrigeration	1 & 2	6	Thermodynamics	Senior elective
		Refrigeration and A.C.		3	Heat Trans.; Thermo.	Graduate course
		Refrigeration and A.C. Seminar		2-6	Refrigeration and A.C.	Graduate course
Iowa						
Iowa City	University of Iowa	Refrigeration		3	Thermodynamics	Senior elective
		Heating and A.C.		3	Steam and Gas Engines; Thermodynamics	Senior elective
Kansas						
Lawrence	University of Kansas	Air Conditioning		3	Thermodynamics	
		Refrigeration		3	Thermodynamics	
		A.C. Laboratory		2	} Heat Power Lab.;	
		Refrigeration Lab.		1	} Air Conditioning	
		A.C. Design		3	Air Conditioning	
Manhattan	Kansas State College	Air Conditioning	2	3	General or Eng. Physics	Elective for students without thermo.
		Refrigeration	1	2	Thermodynamics	Elective
		Air Conditioning	1 & 2	3	Thermodynamics	Graduate and undergraduate elective
Kentucky						
Lexington	University of Kentucky	Refrigeration	1Q & Summer	1 & 3	Eng. Thermo. or Elements of Eng. Thermo.	Required of seniors
		Heat. and Vent. Design	2	1	Elementary H.V. and A.C.	Brief course for arch. eng.
		A.C., Heat. and Vent.	1	3	Refrigeration	Required of seniors
		A.C., Heat. and Vent. Design	2	3	A.C., Heat. and Vent.	Required of seniors
		Elementary Heat., Vent. and A.C.	2	3	Elementary Physics	Elective
Louisville	University of Louisville	Refrigeration	3Q	3	Thermo.; Heat Transfer	Required of 5 yr. students
		Heat., Vent. and A.C.	2Q	3	Thermo.; Heat Transfer	Required of 5 yr. students
Louisiana						
Baton Rouge	Louisiana State Univ.	Refrigeration	1	3	Heat Engines	Elective
		Air Conditioning	2	3	Refrigeration	Elective
New Orleans	Tulane University	Refrigeration	2	2	Thermodynamics	Junior requirement
		Heat., Vent. and A.C.	2	3	Refrigeration	Senior requirement

Engineering Courses Available in Air Conditioning, Refrigeration, Heating and Ventilating—Continued

Location	School	Course	Term Offered	Credit Hours	Prerequisites	Comments
Ruston	Louisiana Polytechnic Inst.	Refrigeration	2	3	Heat. Eng. and Thermo.	Senior requirement
		Heat., Vent. and A.C.	1	3	Heat. Eng. and Thermo.	Senior requirement
Maine						
Orono	Univ. of Maine	Heating and A.C.		3	Thermodynamics	
Massachusetts						
Boston	The Franklin Foundation	Heating, Ventilating and A.C.				3 yr. evening course of college grade—no degree
Cambridge	Harvard University	Heat. and Ventilation		3		Required ordinarily for admission to Graduate School of Engineering
		Air Conditioning		3		
	Massachusetts Inst. of Technology	Air Conditioning	1	3	Heat Engineering	4th yr. elective
		Refrigeration	2	3	Heat Engineering	4th yr. elective
		Applied Refrigeration	2	3	Heat Engineering	4th yr. elective
		Refrig. Engineering	2	3	Heat Engineering	Graduate elective
		Low Temperature Refrigeration	1 or 2	3	Heat Engineering	Graduate elective
		Advanced A.C.	1	3	Air Conditioning	Graduate elective
		Heating and Ventilating	1 or 2	2		3rd yr. architecture course
Medford	Tufts College	Heating, Ventilation and A.C.		3		Extension course
		Refrigeration		3		Extension course
Worcester	Worcester Polytechnic Inst.	A.C. and Refrigeration	1	2½	Thermodynamics	Senior elective. Includes heating
Michigan						
Ann Arbor	University of Michigan	Refrigeration and A.C.	2	3	Thermodynamics	Elective for seniors and graduates
		Industrial A.C.		3	Thermodynamics	Required for industrials; elective for others
		Heating and A.C.		3	Thermodynamics	Required for mechanicals
		Design of Heating and A.C. Systems	2	3	Thermodynamics	Elective
		A.C. Laboratory	2	2-3	Thermodynamics	Senior and graduate elective
		Heating and Ventilation	2	2	Thermodynamics	For senior architectural students
		Studies in Natural Ventilation		2	Thermodynamics	Graduate elective
Detroit	University of Detroit	A.C. and Refrigeration	2	4	Heat Power Fundamentals; Mechanical Drawing	Senior year
		Air Conditioning	2	2⅔		Senior elective
East Lansing	Michigan State College	Refrigeration	3Q	3		Covers construction and use
		Refrigeration	2 & 3Q	6	Thermodynamics	Senior or graduate credit
		Heating and Ventilation	2Q	3	Heat Trans. and Fluid Flow	Senior or graduate credit
		Industrial Heating and Ventilation	3Q	3	Heat Trans. and Fluid Flow	Senior or graduate credit
Houghton	Michigan Col'ege of Mining and Engineering	Heating, Ventilation and A.C.	2 & 3Q	6	Thermo.; Properties of Materials	Senior elective
		Refrigeration	3Q	5	Thermodynamics	Senior elective
Minnesota						
Minneapolis	University of Minnesota	Heating and Ventilating		3Q	Thermo.; Lubrication and Vibration Engineering	Both courses completed in 4th yr.
		Refrigeration		3Q	Heating and Ventilation	
		Heating, Ventilating and A.C. Design		2 per Q	Heating and Ventilation	Elective
		Advanced Heating, Ventilating and A.C.		3Q	Heating and Ventilation	Elective
		Heat. and Vent. Laboratory		2Q	Heating and Ventilation	Elective
		Advanced Heating, Ventilating and A.C.		Cr. Arranged	Heating and Ventilation	Graduate course

Experience is my Classroom

By T. W. REYNOLDS

WHO SAID 25% OF FRESH AIR?

I suppose it is easier to determine why custom has fixed on a certain percentage of outdoor air as necessary in an air conditioning system than it is to determine what the percentage actually is when the system is installed. This predetermined theoretical percentage is customarily fixed at 25% of the total air circulated by the fan, so that it is quite common to find the outdoor air damper set one-quarter open by means of the control. This control has a scale which reads zero when the damper is closed, 100% when the damper is fully open, and anybody's guess at points between.

When the damper is set one-quarter of the way open, the outdoor air admitted is usually well in excess of 25%, because the resistance by this path is less than by way of the recirculating damper. In addition to this difficulty, any wind pressure on the inlet may increase the air admitted by a considerable amount. Attempts to overcome these influences by fixing the position of the damper through measurement of the air flow are usually unsatisfactory, for seldom are the physical conditions such as to permit any reliable measurements.

This 25% of outdoor air rather fascinates one. Who said it first, and why? Theoretically, it doesn't seem to work out too badly; for example, we know that at least six air changes of total air circulated are necessary for good air distribution, so that 25% would give one and a half air changes of outdoor air. This would keep a space well under pressure against infiltration, even after providing make-up air for a reasonable amount of exhaust air.

On the other hand, the total air goes up as the heat gain increases, so the outdoor air increases for no other reason than to maintain the dear old convenient rule of 25%. In any event, the 25% gives more air in most cases than is required per person, so why doesn't somebody do something about it? Why doesn't someone give us something more rational to work with, together with some practical means of knowing if we have what we previously determined we should have?

We fuss over the exact outdoor air quantity when designing, fix our refrigerating capacity to include the heat gain of this load, set the damper by eye to where it indicates one-quarter open, then forget all about the matter and take what we get. Should the refrigerating capacity prove too little for our venture, we close the damper a bit, but if odors are then noticeable at high humidities, or there is but little pressure outward at doors, we open it up again. If this loads the machine to where the required indoor temperature cannot be held, or if someone suddenly becomes economically aware of things, the damper becomes closed as much as the operator thinks is consistent with the other conditions.

ODORS

In a department store the source of an odor is sometimes difficult to trace, especially in a store with many floors where the suction in elevator shafts will cause odors to be pulled all the way from basement to top story. In one store there was a gasoline smell in a portion of the main floor next to its garage. There was a connecting passageway and door to the garage through which it was assumed that the odor entered, but smoke tests proved that the air left by this route. This led to an examination of the air conditioning unit itself. The unit supplied the section of the main floor in question, but was located overhead out in the garage. The garage was not air conditioned, so that, to get some ventilation and cooling effect therein, someone had blocked an access door on the unit partially open and this door was on the suction side of the unit.

Even with the door closed there must be in-leakage of gasoline vapors to the unit. If so they are not noticeable and perhaps not harmful, due to dilution. Obviously, the unit should be soldered tight or preferably located somewhere else, but stores never have any spare space to provide that somewhere else. They expand and take on additional quarters, plan it all out, and end up with space at a premium as before. The sales department is always looking for space to take over.

There was another odor in this same store which penetrated to the uppermost floor. It was generally attributed to the opening of sewer pipes while alterations were going on, but some few thought the odor was one of oil. Eventually, the odor was found to be from oil and was traced to a large vent left temporarily open on the fuel oil tanks in the basement.

An inconspicuous and convenient place for ceiling exhaust registers in stores is often along the elevators. Such registers on upper floors may be many or large and with strong suction effect. If so, they assist the stack effect in elevator shafts whenever the elevator doors are opened, causing a sudden rush of air which is annoying. Exhaust registers will pull air from areas some distance away, but even if the areas are open with practically no apparent restriction to air flow, the registers will pull the air from the place nearest at hand. Where that area already has a push behind it, as in the case within an elevator shaft, the pull is that much more pronounced, as is also the suction on kitchen and other areas where odors should be kept confined.

One of these days when the writer needs air for some purpose or other, such as ventilating a boiler room, he is going to exhaust it from the bottom of an elevator shaft and learn whether he can reverse the air currents in the shaft, or at least neutralize or decrease their effect.

ARE ENGINEERS NARROW?

Are engineers more narrow than others in the industry? The affirmative has often been claimed.

Human nature is pretty much the same, and narrowness is a trait of the human animal, whether salesman or engineer. The salesman gets around a bit more and has to get along with his customers while the engineer leads a somewhat more sheltered life and can be more arbitrary and intolerant. Moreover, the engineer is a gruff individual who can't see every salesman who would like to see him. The salesman thinks he should and that he should be informed about all new products of every type and manufacture. Perhaps he should, but this is a practical world and should he be that well informed there would be no time left in which to specify the product, therefore no need for either the engineer or salesman.

The engineer does not have to defend his prestige because few people pay any attention to malicious remarks, nor is his pedestal, in the eyes of others, as high as he may think it is. Those who do homage to him are but paying worship to his specifications. As for the manufacturer, the writer knows from his own reactions and those of other engineers about him that little attention is paid to slighting remarks of one salesman about another salesman's product. En-

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

gineers are not that simple and so easily influenced. They can appreciate motives and discount such remarks.

Engineering societies may have a meeting with some manufacturer's product featured, of necessity, to some slight degree. Competitors become jealous, yet they have a grand chance of rising up and asking pertinent questions; also they had the equal chance of exposing themselves if they cared to by giving their own lecture. Of course, all this would require some work on their part, photos for slides, sketches, thought, and so on. In the final analysis, if in these meetings the product does become slightly overplayed on some few occasions, the writer never saw any harm done, except to the one who overplayed his hand.

Technical groups need interesting meetings and frequently the findings of manufacturers provide the latest data, the most comprehensive of the moment, and the best. The meetings would be but dull affairs if left to the engineers, yet some engineers do feel that the membership includes too many interested manufacturers, contractors and salesmen. Generally speaking, however, the engineer has less to gain commercially from publicity, so that engineering groups could hardly survive but for the time and effort given it by the manufacturer and salesman.

USE SMALLER DUCTS

Perhaps I shouldn't say this, but sometimes I wonder whether we engineers would be as liberal in the sizing of equipment were we spending our own money. For example, when an engineer is designing his own home it is quite likely that the size of every item entering into it will be most carefully considered and increased only when the large size will effect substantial savings in the cost of operation. There will be no tendency to over size when sized for ourselves, since any inadequacy will bring only disappointment which seems to be easier to take than criticism and loss of prestige affecting earning ability. Designing for someone else is different, because in such cases an insufficient size will bring criticism.

I am thinking at the moment, particularly of the sizing of branch ducts to ceiling supply outlets in air conditioning systems. This is the sort of layout where a sheet metal contractor can go to town if given the go signal. As a rule he can take an engineer's layout and cut the sizes to where a one-third saving can easily be made. What is more, he will guarantee the job and no doubt make it work.

Leaving aside the fact that for some particular make of outlet the catalog may call for lower neck velocities of the outlets and therefore larger outlets and branch ducts, let's consider a case where the engineer designs on a liberal basis and compare it with the way a contractor would size if left to himself. Assume, for example, 400 cfm in a branch duct 14 in. by 6 in. by 8 ft long leading to a supply outlet having a neck diameter of 12 in., the duct, of course, being made 2 in. wider than the diameter of the neck and not too shallow in depth. Such a duct of the customary No. 24 gage would weigh 43 lb with 10% waste included. The velocity within the duct would be only 506 fpm.

Now, the contractor would no doubt choose an outlet with a neck of only 8 in. diameter and therefore cut the duct size to 10 in. by 6 in., which would reduce the gage to No. 26 and the weight to 27 lb, a saving of 37% in weight. The velocity in the duct would now be on the high side at 970 fpm, but neither velocity, sound or resistance would be too high. The saving in duct covering due to reduced size of duct would be 20%, while the total saving in money might well average $15.00 per branch or, say, $5000 to $10,000 in a single structure and this takes no account of savings due to reduced size of outlets.

NIGHT COOLING WITH EXHAUST FANS

The writer has been challenged on his statement that night cooling by exhaust fans, though sometimes economical in purely ventilating systems, should never be resorted to in the conditioned space of a department store. For example, a store with ventilation on a 95F day would reach a temperature of at least 100F by the time the store closed at night. Since in many localities the temperature drops 10F in a few hours at night, the outdoor air at temperatures as high as 90F or 95F might well be used for cooling, providing that this method is not objectionable in other respects.

Now, a store with air conditioning is an entirely different proposition. Such a store would be conditioned daytime only, be held at a day temperature of about 78F, and designed with its supply fans and ducts for a temperature rise in the air of 18F. Here, to do night cooling with the outdoor air, the temperature outdoors would have to be 18F lower, though due to the internal heat gain being much less at night, it might have to be only a few degrees below 78F. Unfortunately, such outdoor temperatures are rather few in the midsummer months.

If the night cooling were to be accomplished by the exhaust fans alone, then the outdoor air temperatures would have to be even lower, since the capacity of the exhaust fans would hardly be equal to the capacity of the supply fans for air conditioning. As a general rule, the exhaust fans would be of insufficient capacity because they are present only for other purposes, such as the removal of odors or excess heat from a localized source, nor are such fans properly distributed for the purpose in mind. If the capacity is increased, or distribution bettered by the adding of exhaust fans, the arrangement becomes expensive, due to money invested in equipment for only occasional use at night.

In any event, who would use exhaust fans for night cooling where there are supply fans of the air conditioning system all connected up to a good distribution system in which the air is all filtered? Due to the superior features of the air conditioning system, this equipment (other than cooling coils) would be operated even though it costs more to do so. Of course, the cost of power would be increased through the use of more fans discharging against much higher resistance. If there are electrostatic filters, even more current would be required and, aside from this, the maintenance of filters is increased where they are used nights as well as days. This is true for all of the equipment, but is of no moment, considering the results.

If air is filtered during the day it would be foolish to bring in unfiltered air by running exhaust fans during the night, especially so where money had been expended for electrostatic filters in the air conditioning system. Another disadvantage of using exhaust fans is that the air is moved inefficiently. It is neither directional nor well distributed and is often short circuited or churned around from open window to fan discharge without doing any useful work.

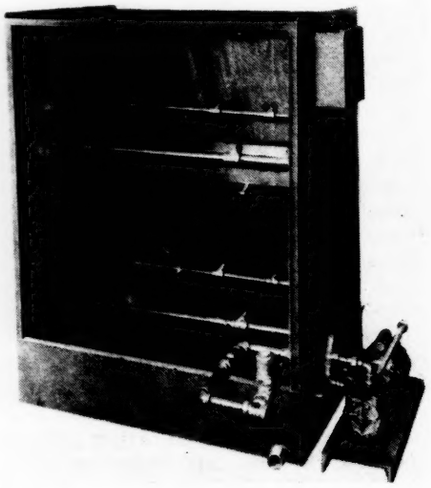
Exhaust fans for night cooling require some locality where, for certain hours of questionable duration during certain nights of questionable number and succession, the average outdoor temperature is appreciably lower for an appreciable time than the temperature in the space at the close of the day. In such cases, who knows what evenings and what hours the outdoor temperature is going to be low enough for cooling. Who knows this in time to find help who would stay around on such short notice and infrequent employment to operate the necessary equipment? Normally, who is around who would be intelligent enough to operate on his own or care enough in any event to operate the system at the right time for the right period? Most certainly any operation at night which heated up a daytime-conditioned building and its contents, due to a rise to higher outdoor temperatures, would be fatal to daytime economy.

The writer, though open to conviction on the entire matter and welcoming discussion, has yet to find an installation where night cooling is feasible and where the actual economy lives up to the great expectations. It is possible to plan a layout with multiple fans of large capacity for most effective cooling; it is also possible to accomplish such cooling more economically in first cost and operation by the prevention of a considerable heat gain directly at the source using, for this purpose, marquees, shade screens and insulation at the roof.

NEWS OF EQUIPMENT AND MATERIALS

Self-Washing Filter

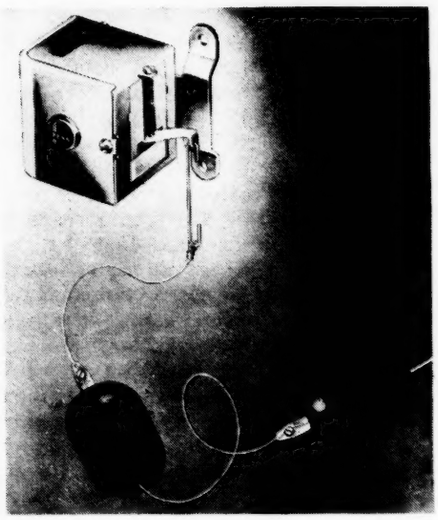
NAME—Far-Air self-washing filter.
PURPOSE—Filter with self-washing feature.
FEATURES—The unit contains banks



of 20 x 20 x 4 in. type 44H filters installed at a 30 deg. angle towards the air flow. Automatically controlled water and oil nozzles on the entering air side of the filters, periodically wash and re-oil the filter surfaces. Nozzles are said to water-scour the entire filter media. An electrically operated valve controls the amount of water used during the washing cycle. After washing, a residual film of oil remains to protect the filter and to keep it at a high operating efficiency. A constant displacement pump, controlled by a timer, is operated to supply the necessary amount of oil. Check valves are placed to insure a full supply of oil in the piping system.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Farr Co., Los Angeles, Calif.* **91**

Sump Pump Switch

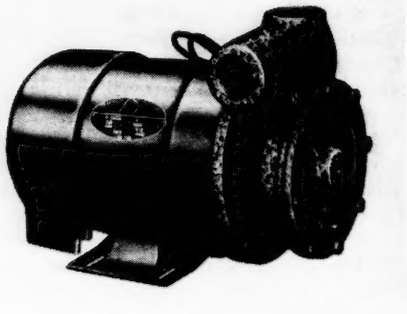
NAME—Penn Electric sump pump switch.
PURPOSE—Switch to control the operation of a sump pump.
FEATURES—Switch uses two weights made from composition material, one of which is mounted on a flexible wire cable at low liquid level while the other is at a point of high liquid level. These weights open and close the switch contacts as required by the liquid level in the pump. Makers claim that friction is virtually eliminated because the total travel of the weights is approximately 1/16 in. Incorporated in this unit is a heavy duty two-pole snap-action contact mechanism to provide added protection by breaking both sides of the line.
SIZES AND CAPACITIES—Two models, one for internal mounting in NEMA standard motor end bell used on many sump pumps, and the other is provided with case and bracket for external mounting. Both models are rated at 1 hp, 115 volts, and 230 volts a-c; and ½ hp at 115 volts and 230 volts d-c.



LITERATURE AVAILABLE — Bulletin 2708.
MADE BY—*Penn Electric Switch Co., Goshen, Ind.* **92**

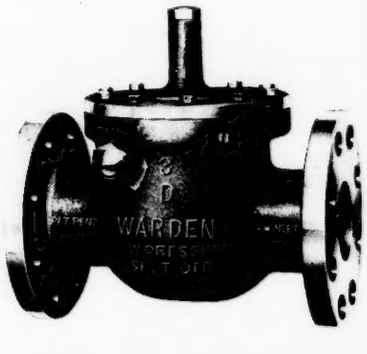
Pump

NAME—Monobilt.
PURPOSE—Combined motor and pump assembly for installations requiring from 2 to 10 gpm.
FEATURES—Unit has replaceable heads and impeller to facilitate quick repairs and also for changing capacities if desired. Assembly, makers claim, has resulted in the elimination of coupling noises. Unit has a single phase, 110- to 220-volt, 60-cycle capacitor type motor with ball bearing construction and stainless steel shaft. Pump is available in three standard constructions—bronze-fitted, all iron, and all bronze.
MADE BY—*Roy E. Roth Co., Rock Island, Ill.* **93**



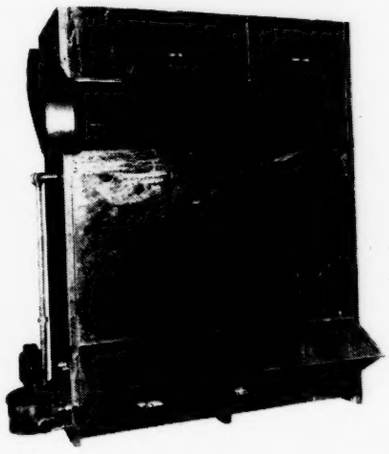
Shut-Off Valve

NAME — Warden automatic low pressure shut-off valve.
PURPOSE—Positive closure valve for use on gas or fluid lines where closure is desired when pressure fails from any cause.
FEATURES—The mechanical action is entirely self-contained; the mechanism is not dependent on external actuating forces. Valve must be reset manually after closure. Valve is set to close at pressure specified and is available in models for both high and low pressure use. A stainless steel valve disc spring provides positive closure when the closure pressure point is reached. The valve disc has a synthetic rubber face suitable for use with gas or oil. Valve body, bonnet, and working parts are made of bronze.
SIZES AND CAPACITIES—From ¾ to 8 in. size.
LITERATURE AVAILABLE—Folder.
MADE BY—*Security Valve Co., 410 San Fernando Rd., Los Angeles, Calif.* **94**



Evaporative Condenser

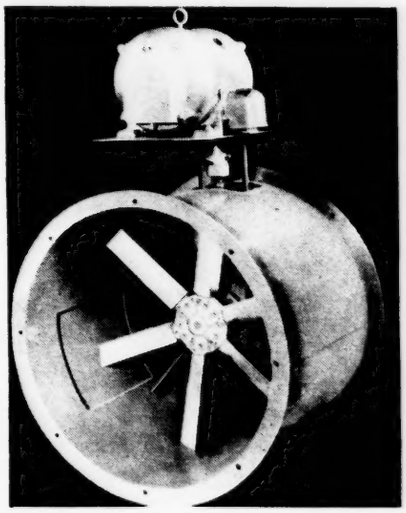
NAME—Acme evaporative condenser.
PURPOSE — Cooling by evaporation to save condensing water.
FEATURES—All steel parts, including wheels and scrolls, are com-



pletely hot-dip galvanized after fabrication. Units are assembled using stainless steel nuts, bolts and screws. All AP and FP models are built with ¾ in. full weight steel pipe coils, hot-dip galvanized after fabrication. FC models are made with copper tube coils. The base sump is built of 11-gage panels—11-gage bottom panel and 14-gage rear panel. Included in the base sump is a Micromet water treatment basket to be used in localities in which corrosion and scale may be brought about by the type of water available. Blowers are die formed of heavy gage steel. Shaft mountings have self-aligning, sealed ball bearings.
MADE BY—*Acme Industries, Inc., Jackson, Mich.* **95**

Propeller Fan

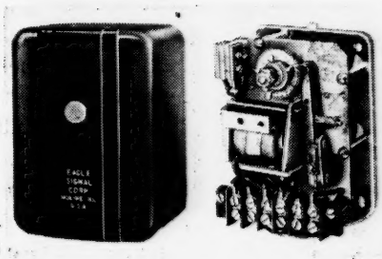
NAME—Chicago axial Airflo propeller fan.
PURPOSE—For heavy duty applications in cooling or exhausting fumes and dust.
FEATURES — Airfoil section type blades have been designed so that at a given rpm the brake horsepower will remain nearly constant from a free air delivery to a completely blocked off condition. Orifice mounting panels are formed from one piece of heavy gage steel. The combination mounting panel and orifice have been designed to minimize turbulence and entrance and discharge losses. Axial airfoil blades are of the adjustable pitch type with diameters from 14 to 48 in. Blades and hubs are cast separately and are made of aluminum alloy. By increasing or decreasing speed, or by changing blade pitch, one unit can be made to serve a variety of conditions. Motor, placed directly in the air stream, is fully enclosed. Where the motor is placed out of the air stream, it is of the open type. Single phase motors up to and including ¾ hp at 1750 rpm are supplied in the split capacitor type; split phase motors are available in ¼ hp and smaller. Polyphase motors are furnished for dual voltage for 220 and 440 volts and are of the squirrel-cage, induction type, totally enclosed when in the air stream, and standard open when not.



MADE BY—*Chicago Blower Corp., 4558 W. Congress St., Chicago 24, Ill.* **96**

Timoflex Time Control

NAME—Timoflex delay relay.
PURPOSE—For timed closing or opening of electrical circuits.
FEATURES—Relay is available in three basic forms, making it adaptable for general use in industrial control circuits. One type starts the timing when the pilot switch is closed; another when the pilot switch opens, and the third when a push button is closed momentarily. Operation is provided by a slow speed, synchronous motor with a separate reset coil to release the timing mechanisms. In addition to the motor, unit has only two rotating parts.



SIZES AND CAPACITIES—Mounting space of 3 x 4½ in. is required. Available timing scales of 55 sec, 5½ min, 27½ min, and 55 min.
MADE BY—*Eagle Signal Corp., Moline, Ill.* **97**

Heater

NAME—Comforteer utility heater.
PURPOSE—Space heating with gas as fuel.
FEATURES—Steel construction is used plus a single piece, cast-iron burner with raised ports. Unit is of the direct-type unvented circulator with an input rating of 12,000 Btu per hr for model 112 and 8000 Btu per hr for model 108. Heater can be used with any type of gas. An orifice of the proper size inserted in the brass valve automatically maintains a suitable type of flow without any special adjustments.

MADE BY—*Inland Steel Container Co., 325 N. Cortez St., New Orleans 19, La.* **98**

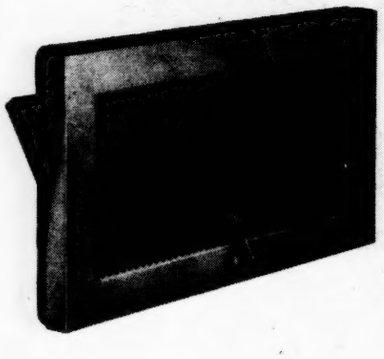
Sump Pump

NAME—Lancaster sump pump.
PURPOSE—For carrying off waste liquid from boiler rooms and from pits.
FEATURES—Pump is a submerged centrifugal type with all bronze balanced impeller. A cast brass strainer is built into the pump base above the impeller. A stainless steel shaft sleeve rotates in a bronze bearing to provide free rotation after long lay-off periods. Operation is controlled by a built-in switch and a large copper float. The 1/3 hp motor has overload protection and is provided with ball bearings. The main bearing in pump base is all bronze, liquid lubricated. Standard discharge tapping is for 1½-in. pipe.

SIZES AND CAPACITIES—Available in 3 and 5 ft total height.
MADE BY—*Lancaster Pump & Manufacturing Co., Inc., Lancaster, Pa.* 99

Baseboard Grille

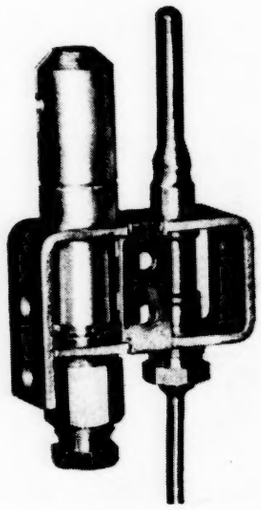
NAME—M-H D510A baseboard discharge grille.
PURPOSE—Control air outlet.
FEATURES—Grille is of steel construction with a ⅞ in. flange on all four sides. A sponge rubber seal-off strip is provided to make an airtight installation and to avoid air streaking around the frame. Unit has an adjustable single shutter damper. Vanes are individually adjustable to provide any desired air pattern up to 90 deg. total diffusion. When shipped, unit has a prime coat finish.



SIZES AND CAPACITIES—Three sizes—10x6 in., 12x6 in., and 14x6 in.
MADE BY—*Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.* 100

Annulair Pilot Burner

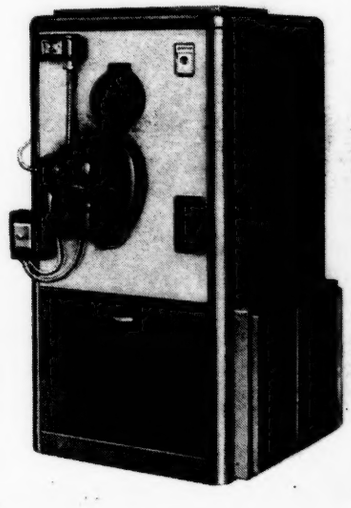
NAME—Annulair pilot burner—Type D.
PURPOSE—Pilot designed to provide a stable pilot flame under wide variations of gas pressure in high ambient temperatures.
FEATURES—Annulair type of primary air opening results, it is said, in a lower velocity of aspirated air so that heavier dirt particles are not sucked into the openings, and lighter particles that may pass into the burner go on through to be burned in the pilot flame. Dual orifice inlet fittings are replaceable for any type of fuel gas and produce so thorough a mixing of air and gas, it is claimed, that flashback will not occur nor will the pilot ignite at the orifice. Air shutters are not necessary with this burner. Pilot tip is of stainless steel and the bracket is stamped of steel and furnace brazed into one piece. Burner is designed for direct mounting to the main burner casting. Dual orifice inlet fittings are replaceable for use with any fuel gas.



SIZES AND CAPACITIES—Available in two standard mounting brackets and nine tips.
LITERATURE AVAILABLE—Bulletin S-473.
MADE BY—*Milwaukee Gas Specialty Co., Milwaukee 1, Wis.* 101

Warm Air Furnace

NAME—Winterglo.
PURPOSE—Oil-fired winter air conditioner for small homes and individually heated apartments.
FEATURES—Unit has a coordinated Arcoflame oil burner and controls mounted on the outside front of the furnace jacket for easy access and adjustment. Unit is factory assembled and pre-wired. Furnace has a steel heating element and a stainless steel combustion chamber. Seams are electrically welded and blower unit is of the double inlet type operated by a motor with built-in overload protection. Motor is equipped with an adjustable pulley to permit change of blower speed. Blower has rubber mounted self-aligning bearings, and the whole blower assembly is mounted on rubber. Filter and filter frame can be attached to either side of furnace.
SIZES AND CAPACITIES—57¾ in. high; 28 in. wide; and 28 in. front to back. Available in two sizes with a bonnet output of 85,000 and 105,000 Btu per hr.
MADE BY—*American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.* 102



Warm Air Distributor

NAME—General Electric Air-Wall heating.

PURPOSE—New method of distributing heat from warm air furnaces through small size ducts so that

the warm air covers a cold outer wall.

FEATURES—Special registers and grilles installed near the baseboard direct the forced warm air upward in a fan-like pattern in front of the wall to provide a warm air blanket on the wall in which the register is installed. Makers claim that although air distribution fans out, yet several inches from the front of the grille no movement of air can be detected. System starts with a special plenum chamber with a number of knock-outs to connect air ducts from chamber to upper room registers. At present this chamber has been designed to fit the air outlet of GE furnaces but the same system can very well be used with other type furnaces. Round 4-in. dia ducts are used to supply air to individual louvers. Near the plenum chamber each duct has a damper for controlling room temperatures in the rooms served by specific ducts and balancing the system. Each register has a damper which can be set as fully open or fully closed. Velocity of air in the ducts is slightly higher than with other type systems. The ducts and plenum chamber are made of 28-gage aluminum. With the exception of the elbows, all sheet metal work is shipped knocked-down to be assembled on the job. Duct joints are taped to prevent air leakage. The elbows are assembled so that each section can be rotated slightly to provide for any angle or offset that may be necessary in the installation. At the present time, this system of air distribution is constructed for the small type house although the unit may be expanded to include the larger home.

LITERATURE AVAILABLE—Illustrated booklet.

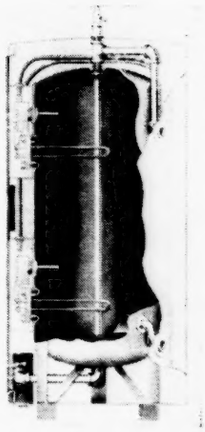
MADE BY—*General Electric Company, Air Conditioning Dept., Bloomfield, N. J.* **103**

Water Heater

NAME—John Wood automatic electric water heater.

PURPOSE—For providing domestic hot water.

FEATURES—Two immersion type elements are used for heating the water. A nicrochrome wire is embedded in refractory material under pressure and encased in copper sheaths. Thermostats, heating element connections, controls, and drain faucet are all located behind a single, easily removed front panel. A cold water inlet baffle is installed to minimize cold water turbulence.



SIZES AND CAPACITIES—10, 30, 40, 52, 66, and 80 gal.

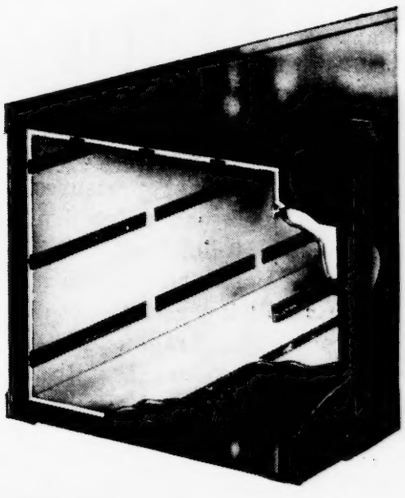
MADE BY—*John Wood Mfg. Co., Inc., Conshohocken, Pa.* **104**

Duct Liner

NAME—Insuliner.

PURPOSE — Insulation for lining flues, ducts, and breechings.

FEATURES—Insulation is in block form made from mineral wool.



Special castings are designed to hold the insulation and hard surface material in place. They are applied to the block insulation and bolted through to the steel. A T-section provides a key to hold the surface layer in place. Castings are available in 21 in. lengths with a hole in the center and lugs 4½ in. from each end. Break-off notches are provided 3 in. from each end to permit closer centers where necessary. After installing the block insulation and bolting the castings in place, a refractory surface is applied with a trowel. Studs are welded to the steel shell of the duct at proper intervals (one for each casting) to eliminate the necessity for drilled holes. All elements are standardized so that the estimating of the amount of material required is simplified.

LITERATURE AVAILABLE—Folder.

MADE BY—*M. H. Detrick Co., 111 W. Washington Street, Chicago 2, Ill.* **105**

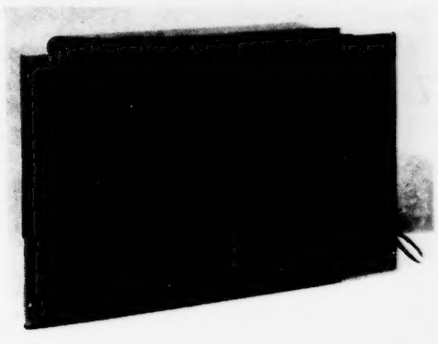
Climax Evaporative Cooler

NAME—Climax 3-speed 1500 evaporative room cooler.

PURPOSE—Room cooling through evaporative means.

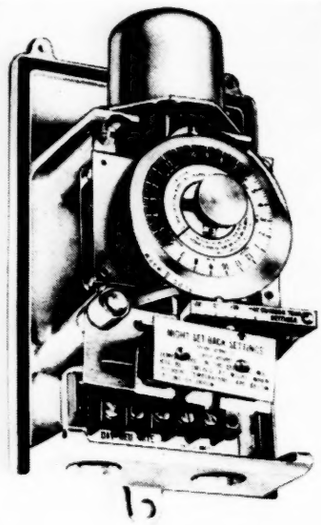
FEATURES—Heavy steel plate construction is used with the louvers on front adjustable to direct air flow. Adjustable extension panels fit windows up to 39¾ in. A 3-speed choke coil and switch are installed for controlling the rpm of the motor and the amount of air delivery. A regulating valve controls the amount of water needed for evaporation. The filter pad that comes with the unit can be easily removed and replaced.

MADE BY—*Climax Machinery Co., 301 S. La Salle St., Indianapolis 6, Ind.* **106**



Weather Control

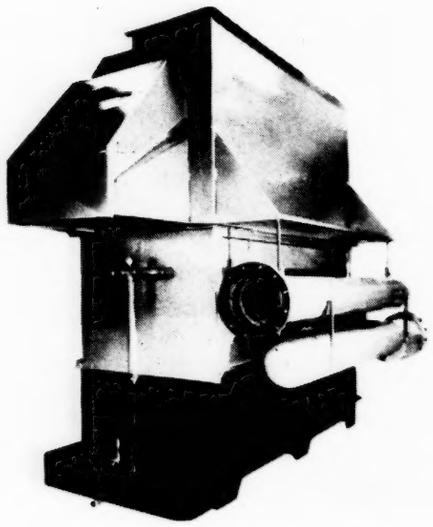
NAME—Weather-Chron.
PURPOSE — Automatic control of night set-back temperature of building.
FEATURES—Unit is wired into the



regular room thermostat circuit. Instead of setting the control for the time heating is to start, it is set to the time the building is to be warm every morning. Unit is said to anticipate the building needs for heat and to automatically change the time heating starts each morning, and shuts down each evening, depending on weather conditions. During the day the regular room thermostat maintains building temperatures at the comfort level. Should outside temperatures drop below a pre-selected level, the nighttime building temperatures will be held at the daytime level. When outdoor temperatures rise above 65F, heating is discontinued.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Weather Controls Div., Automatic Devices Co., 53 W. Jackson Blvd., Chicago 4, Ill.* **107**

After Cooler

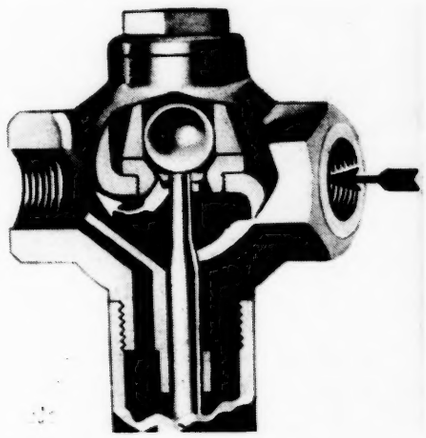
NAME—Niagara Aero after cooler.
PURPOSE—For dehydrating compressed air or gas.
FEATURES—Temperature of compressed air or gas is lowered to a point below the dry-bulb temperature of the atmospheric air so that moisture condenses to prevent further condensation of water in air or gas lines. Water spray is evaporated on the surface of a coil through which the compressed air passes, thereby creating a temperature close to the wet-bulb temperature of the surrounding atmosphere and lower than the dry-bulb temperature. A thermostat in the spray water reservoir is set for a desired low temperature limit at which it operates the dampers to recirculate the air stream internally around a division plate in the center of the unit instead of drawing in air of freezing temperature. This permits outdoor installations. Unit is said to consume less than 5% of the cooling water required by conventional coolers. A balanced wet-bulb control protects against freezing.



MADE BY—*Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.* **108**

Valve

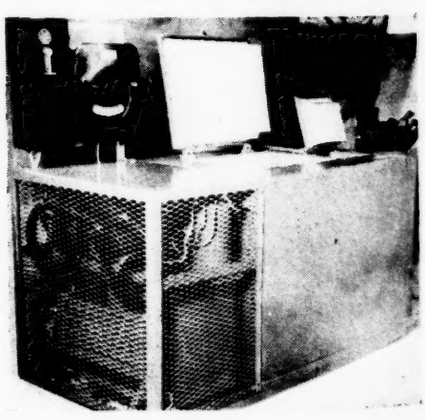
NAME — Klipfel ball type inner valve.
PURPOSE—For accurate flow regulation for steam, water, air or gas applications at inlet pressures of less than 250 lb and reduced pressures below 150 lb.
FEATURES—Valves are single seated with a ball inner valve actuated by a rubber diaphragm. The ball centers freely on the seat with uniform contact all around. Ball closes tight the moment it seats. When off the seat, the ball is free to turn so that all parts are exposed in turn to the scouring action of the flow. Ball is made of stainless steel, heat-treated for extreme hardness. This inner valve construction is used on all valves of the 400 series, including reducing valves made by this company.



MADE BY—*Klipfel Manufacturing Co., Div. of Hamilton-Thomas Corp., Hamilton, Ohio.* **109**

Test Cabinet

NAME—Industrial cold low temperature test cabinet.
PURPOSE—Refrigerated cabinet for use in test work.
FEATURES—Unit has a rapid pull-down of temperature to as low as —240F. Refrigeration system employs two stages of compression with refrigerant control being handled by high side floats.
SIZES AND CAPACITIES—Produced in various sizes to meet special applications and in temperature ranges of zero to —50F, —50 to —80F, —80 to —120F, and —140 to —240F.
MADE BY—*Industrial Cold Co., 14550 Third Ave., Detroit 3.* **110**



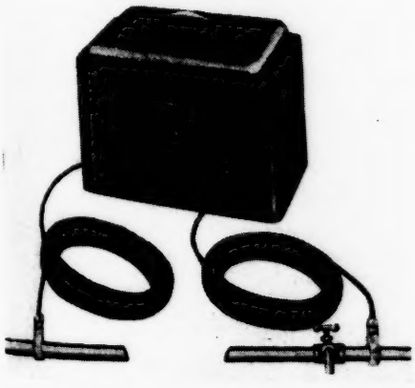
Chemical Gage

NAME—Chemical gage.
PURPOSE—Pressure indicating instrument for use where chemicals and other viscous liquids might

tend to corrode or clog the Bourdon tube.
FEATURES—Diaphragm is made of Teflon, said to be capable of resisting corrosive action of chemicals. Diaphragm chamber can be supplied in the type metal most suitable for the type service for which the gage is intended. Gage system above the diaphragm is filled solid with glycerine and water or silicone oil.
SIZES AND CAPACITIES—Dial sizes of 4½, 6 and 8½ in.; for pressures to 1600 lb per sq in. and temperatures of 300F.
MADE BY — *Helicoid Gage Div., American Chain & Cable Co., Bridgeport 2, Conn.* **111**

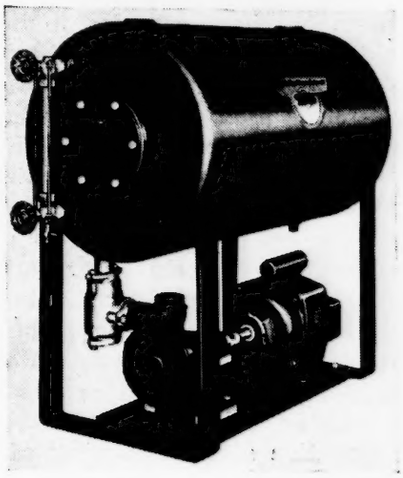
Pipe Thawer

NAME—Trindl electric pipe thawer.
PURPOSE — Portable pipe thawing unit for operation with 110 or 220 volt, a-c current.
FEATURES — Unit comes complete with 40 ft of output cable, 10 ft of power cable, and pipe clamps. Unit is carried to the job for operation with 110 or 220 volt, 50 or 60 cycle, a-c current.
MADE BY — *The Trindl Products Co., 17 E. 23rd Street, Chicago 16, Ill.* **112**



Boiler Feed

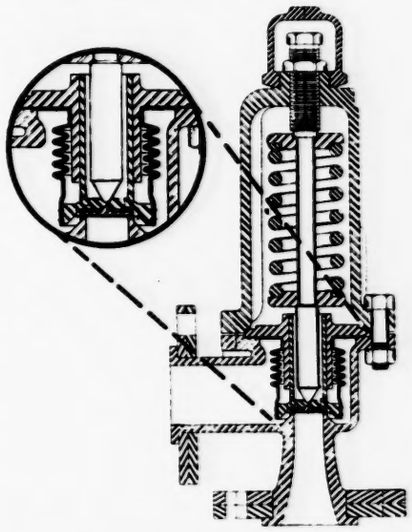
NAME—Roth boiler feed.
PURPOSE — For automatically providing make-up water for use with small high pressure boilers.
FEATURES — Bronze fitted turbine type pump is used with sealed-in grease bearings. A special strainer with gland type connections eliminates, it is said, noise transfer



through pipes. Shortened piping to pump section is claimed to protect against vapor binding. Horizontal tank is of 20 gal. capacity.
OPERATION—Pump motor is controlled by water level controller mounted on the boiler. Controller starts the pump when water level in the boiler is low and stops when the water level is high.
SIZES AND CAPACITIES—Five sizes for boilers from 1 to 20 hp at operating pressures up to 100 lb.
MADE BY—*Roy E. Roth Co., Rock Island, Ill.* **113**

Safety Valve

NAME—FarriSeal bellows.
PURPOSE—Safety valve construction which isolates the lading fluid from the valve spring chamber.
FEATURES—Design prevents gases or liquids from entering the spring chamber and thereby corroding the



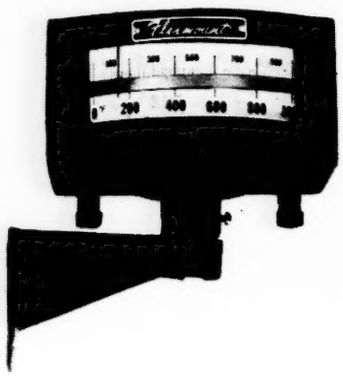
spring. Unit is an enveloping bellows that is built into the valve. While the standard is made of type 316 stainless steel, it is also available in rubber and neoprene for special applications. Bellows is designed to permit the safety valve its full stroke plus over travel and at the same time never to reach the stress limits of the bellows. Makers claim that the unit has been satisfactorily used for applications where back pressures have been as high as 150 lb.
MADE BY — *Farris Engineering Corp., 493 Commercial Ave., Palisades Park, N. J.* **114**

Draft Control

NAME—Scotty Field.
PURPOSE—Draft control for space heaters.
FEATURES — Control is fabricated from 26-gage steel with a 6-in. diameter, 10-in. long tee. A large diameter, counter-balanced gate operated on an extended 4-13/16 in. collar is located beyond the flow of heat and smoke, recessed to direct air entering the collar against the gate. Gate is adjustable for high, medium or low drafts and revolves to permit vertical or horizontal mounting.
MADE BY—*Field Control Div., H. D. Conkey Co., Mendota, Ill.* **115**

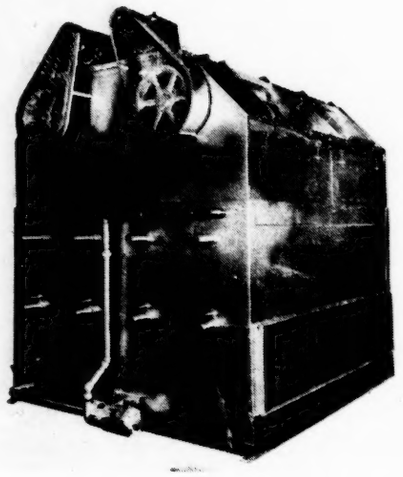
Pyrometer

NAME—Flexmount pyrometer.
PURPOSE — Pyrometer instrument for flexibility in installation.
FEATURES—By adjustment of a setscrew the meter case can be moved in a horizontal arc from zero to 180 deg. so that readings can be provided in all directions. Instrument is housed in a metal case and has a mirrored scale 3¾ in. long with large numerals. A high resistance movement permits slight changes to be made in the external resistance of the thermocouple of lead wire without the need for recalibration. Cold junction compensation automatically adjusts for variations in ambient temperature to assure accurate readings at the thermocouple hot junction. Accessories include thermocouples and protective tubes.
MADE BY—*Pyramid Instrument Co., 117 Lafayette St., New York 13, N. Y.* 116



B.A.C. Evaporative Condenser

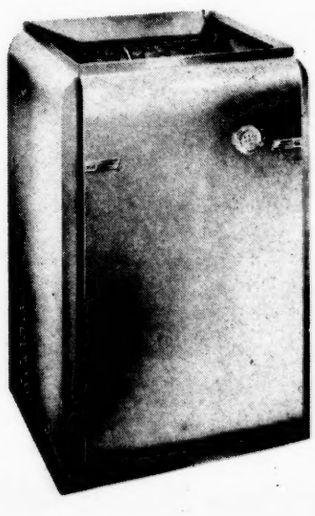
NAME—B.A.C. evaporative condenser—model U.
PURPOSE—For the condensing of ammonia, methyl chloride and Freon refrigerant vapors.
FEATURES—Line of model U condensers has been extended to include the 125-ton unit illustrated. Large, low outlet velocity, centrifugal fan is used, driven by a continuous duty motor with drip proof frame. Motor is wired for 3-phase, 220/440-volt, 60-cycle current. A close coupled centrifugal pump is used with both pump and motor, parts of a single unit. Condensing coils have steel tubes, hot-dipped after fabrication. Coils are designed for a low pressure drop. Coil surface is 12 sq ft per ton refrigeration at rated nominal capacity. Brass spray nozzles are used. Sump pan is constructed of heavy gage steel, welded construction, and then hot-dipped galvanized. Condenser is suitable for indoor or outdoor duty and is designed so that the air is discharged from the top at a 45-deg. angle. By using an elbow this discharge can be directed either vertically or horizontally. Flanges for duct connections are provided on each fan outlet.



SIZES AND CAPACITIES — 10 - 125 ton.
LITERATURE AVAILABLE — Bulletin No. 17.
MADE BY—*Baltimore Aircoil Co., Inc., 715 W. Pratt St., Baltimore 1, Md.* 117

Blower-Filter

NAME — Lau package blower-filter 9000 series.
PURPOSE—To step up efficiency of a gravity type warm air furnace; and to circulate warm dust-free air in a home.
FEATURES—A center - suspension blower wheel is used. Two air filters of the throwaway type, each 1 in. thick, are installed to provide dust-free air. Rubber cushioned bearings and motor result in quiet running and vibration elimination. Unit is constructed of heavy gage steel and comes complete in one package with the exception of the motor. Large access door enables easy servicing of motor or filters. If desired, cold air return can be fitted to the top of the unit.
MADE BY—*The Lau Blower Co., Dayton 7, Ohio.* 118



MARCH, 1949

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118		

Print your name and address, detach and mail to Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

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NEWS OF THE MONTH

JANUARY WEATHER

sets contradictory records in all parts of the United States. Cold in West. Warm in East.

January, 1949, was characterized by marked extremes of weather conditions in different portions of the country. The outstanding features were the abnormal warmth in the East and the severe cold in the West: damaging freezes in southern Texas and the extreme Southwest; the severe and frequent ice storms in the Great Plains and portions of the Midwest; and frequent high winds and extensive deep snowcover in the western portion of the country, with blizzard conditions in sections of the central and northern Great Plains and central Rocky Mountain region, setting new records for frequency and duration.

• **BLIZZARDS.**—The blizzard of January 2 to 5 was one of the most severe of record in the central Great Plains area. At Rapid City, S. Dak., average wind velocities on the 3rd and 4th were above 50 mph, with extremes above 70. The temperatures remained below zero, and visibility was less than 5 ft the greater part of the two days. Fourteen inches of snow fell, with drifts 15 ft high at Rapid City, while railroad and highway cuts west of the city were filled to a depth of more than 20 ft.

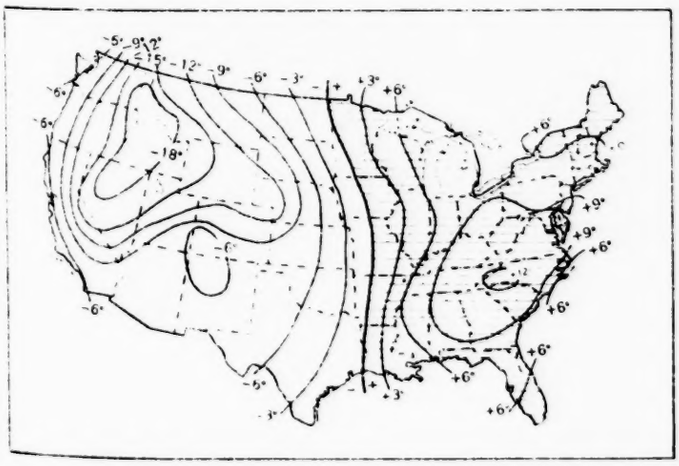
Somewhat similar conditions which prevailed in western Nebraska on January 3 to 5 were described as the worst ever to visit that region, although temperatures were not quite as low as during some other storms. At North Platte, the wind velocity was 41 mph on the 3rd, with gusts up to 65 mph. The day's snow totalled 8.8 in. Monthly totals at many stations in northwestern and north-central portions of Nebraska ranged from 8 to over 25 in., with a total of 73.3 in. of snow at Hay Springs thus far this winter.

The duration of blizzard conditions at Cheyenne, Wyo., was the greatest of record. After the record blizzard of January 3 to 4 at that station, cold waves occurred at intervals throughout the month. Also in North Dakota blizzard conditions prevailed during the greater part of the month. Throughout the blizzard areas, traffic was either blocked or made difficult. Many communities were isolated and some were still snowbound at the end of the month. Much livestock was stranded on the open ranges and losses were heavier than usual.

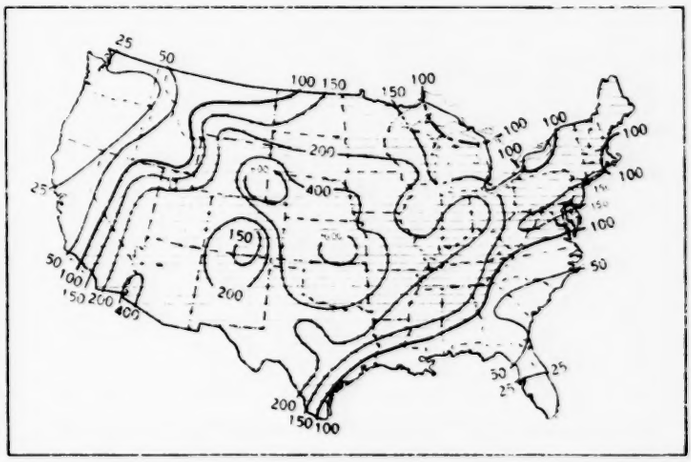
• **COLD.**—This January was the coldest on record in Missoula, Mont., Boise, Idaho, Fresno, Bakersfield, and San Diego, Calif., and Salt Lake City, Utah. The temperature fell below zero on 22 days at Missoula, and frost penetrated to a depth of 7 ft in some sections of the city, bursting thousands of water pipes. Temperatures fell below freezing for 24 days at Fresno, Calif. Ice formed on several mornings at San Diego and snow covered the ground in several sections of the city. A 24-hour snow of 7.1 in., snow depth on the ground of 23 in., and a low of —22F were only a few of the new records established at Salt Lake City, Utah, during the month.

Ice storms were extremely severe in portions of Missouri, occurring on about nine days in the Springfield and Columbia areas. These ice storms were also severe in Oklahoma and southeastern Kansas. At the end of the month, one of the most extensive ice storms ever to occur in this country glazed a large portion of the lower Great Plains, central Gulf areas and much of the Midwest and East. Damage from these storms will total several million dollars.

• **1937 SIMILAR.**—The 1937 January temperature pattern was similar to January 1949. Of the 17 States in the cold section shown on the map, the lowest average temperature in 12 of them occurred during January 1937. The average temperature for January 1949 is expected to be the lowest of record for about 3 States when complete reports are in. On the basis



Departure of mean temperature from normal for January, 1949. Shaded areas normal or above.



Percentage of normal precipitation for January, 1949. Shaded areas normal or above.

of temperature, January of 1937 was colder in the western portion of the country than January 1949. However, in 1937, high winds were not as frequent and the snow cover was neither as deep nor as extensive. Temperatures almost as low as those in 1937, combined with high winds, a deep snow cover, and long duration of blizzard conditions makes the weather of 1949 the worst January ever experienced in that section.

• **SPOT REPORTS.** — *Oakland, California,* had the coldest month on record since 1929 and reported 726 degree-days against a normal of 527. *San Diego* reported coldest month on record with a mean temperature of 47.8, 6.2 degrees below normal.

Phoenix, Arizona, reported that January was the second coldest month on record. Citrus fruits and vegetables suffered severe frost damage.

Boise, Idaho, had the coldest month and driest January on record with only 4.3 in. of snow and temperatures averaging 17.6 degrees below normal. Degree-days were 600 higher than normal.

Billings, Montana reported the coldest month on record since January, 1937, with a total of 23.1 in. of snowfall. Seven Montana cities reported unusually severe January weather showing from 500 to 600 more degree-days than normal.

North Platte, Nebraska, reported an exceptionally cold and windy January, 11.3 degrees below normal, with the severest blizzard on record occurring January 2 to 4 and totaling six inches of snowfall.

Ely, Nevada, had the coldest month during the history of the station. A new record of —27F was set in January, and livestock and wild game suffered large losses due to deep snow and low temperatures.

Cheyenne, Wyoming, reported a record blizzard on January 2 to 4 with 15.1 inches of snow in which nine persons lost their lives. Mean temperature for the month was 14.1, 11.4 degrees below normal and the lowest January mean since 1937.

All states west of Minnesota and Louisiana reported mean temperatures from 6 to 18 degrees below normal and precipitation as much as 600% above normal.

• **EAST.**—In eastern states, the opposite extremes prevailed. *New Haven, Connecticut,* reported the warmest and wettest January since 1937, with only three clear days all month and a mean temperature 8.3 degrees above normal.

Macon, Georgia, reported a mean temperature of 56 degrees, the second highest on record, and the only January in history with two days showing maximum readings of 80 degrees or higher. In *Savannah,* too, the mean temperature was 10.1 degrees above normal.

Chicago, Illinois, reported an unusually mild January and the wettest January since 1929. *Dubuque, Iowa,* reported a mean temperature 3.9 degrees above normal during the wettest January since 1937. Snowfall was the heaviest since 1936. New maximum temperature records were set on the 7th (51F) and 15th (52F). In *Sioux City, Iowa,* during the last half of the month, a mean temperature averaging only 5 degrees above zero with blizzard conditions during the nights of the 27th and 28th caused much damage.

Portland, Maine, reported an extremely warm January, 6.5 degrees above normal, with a snowfall of 21.3 inches, slightly higher than normal.

Detroit, Michigan, had the warmest January since 1933. A severe windstorm on the 19th caused a number of plate glass windows, chimneys, and roofs to be damaged. Wind velocity reached 57 mph with gusts to 75 mph.

In *Jackson, Mississippi,* the highest mid-winter temperature ever recorded was on January 10th, when the thermometer reached 85.

Concord, New Hampshire, reported a monthly mean temperature 8.7 degrees above normal.

New York City reported the warmest January since 1932 and the fifth warmest month on record. January, 1949, was 33% warmer than January, 1948, and 21% warmer than normal. Monthly mean temperatures throughout New York State were six to nine degrees above normal.

Cincinnati, Ohio, had the warmest January since 1932, the lowest minimum temperature of the season was on the 30th while the record maximum temperature of 68.6 was on the 9th.

Philadelphia, Pa., averaged 13 degrees warmer than in January, 1948. Precipitation was reported severest on record for January. Temperatures throughout Pennsylvania were seven to nine degrees above normal.

Columbia, South Carolina, had the warmest and driest January on record, with monthly mean temperatures 10.1 degrees above normal.

THREE APPLIANCE FIRMS

form new company to produce full line of gas-fired equipment.

Formation of Affiliated Gas Equipment, Inc., with headquarters in Cleveland has been announced by Lyle C. Harvey, president and general manager of the new corporation. The new organization represents the combining in a single unit of three manufacturing companies with a full line of products in the heating, water heating, and year-round air conditioning fields. All of the participating companies were previously subsidiaries of Dresser Industries, Inc. They are the Bryant Heater Co. of Cleveland, the Day & Night Manufacturing Co. of Monrovia, California, and the Payne Furnace Co. of Beverly Hills, California.

L. C. Harvey

• **FINANCE.**—Affiliated Gas Equipment, Inc., is offering to the public 1,000,000 shares of $1.00 par value common stock at an offering price of $9.25 per share and 40,000 shares of $3.00 cumulative preferred stock, par value $50.00 per share, being offered at par. The underwriting group offering this financing i

headed by Reynolds & Company of New York. The company has secured a 15-year term loan from three insurance companies for a total of $4,000,000.

• **PLANT.**—Five major producing plants are merged in this single organization and will manufacture a line of gas-fired equipment for both heating and water heating in the residential, commercial, and industrial markets. Two of the Bryant Heater Division plants are located in Cleveland, with a third in Tyler, Texas. The Day & Night Division property is in Monrovia, California, while the Payne Furnace Division plant is in Beverly Hills, California.

• **PRODUCTS.**—Products of the Bryant Division include boilers, furnaces, unit heaters, conversion burners, water heaters, circulating heaters and radiant-panel wall heaters, as well as industrial gas-burning equipment. The Day & Night Division will continue to produce gas-fired water heaters, water coolers, space heaters, a gas-fired radiant wall heater and a new overhead radiant space heater. Payne Furnace Division's products include warm-air furnaces, room heaters, a new evaporative cooler for residential, commercial and industrial use, a new forced-air panel heater unit, and a completely new line of central plant gas-fired furnaces. Each organization, operating as a division of the parent corporation, has retained its individual identity, its trade name, trade marks, trade relations, and executive personnel.

• **EXECUTIVES.**—President Lyle Harvey, who is general manager and a director of AGE, is also general manager of the Bryant Heater Division. He is a past director and executive committee member of AGA, and a director and past president of GAMA.

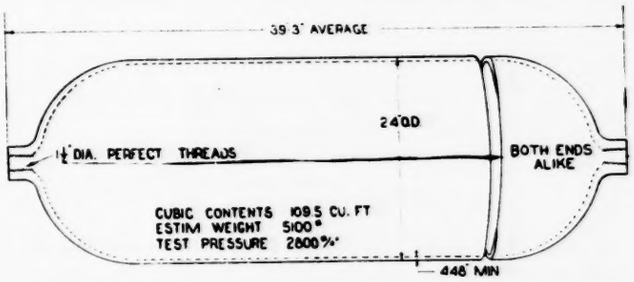
Associated with Mr. Harvey are Philip W. Scott, formerly secretary-treasurer of the Bryant Heater Company, who occupies a similar post with the new AGE; W. J. Bailey, Jr., who is also a vice president and director of AGE while serving as general manager of the Day & Night Division; and General Manager E. L. Payne of the Payne Furnace Division, who is a vice president and director of AGE.

HIGH PRESSURE STORAGE

of gas a nationwide possibility as engineers set royalty rate on underground system.

D. V. Meiller and M. G. Markle, who are associated with the Public Service Company of Northern Illinois in gas engineering and who invented a system for the underground storage of natural gas under high pressure, have announced adoption of a policy which will make available to any prospective user of the system a license under their patent rights at a uniform royalty rate of 60 cents per thousand cu ft of storage capacity.

Licenses, they said, will be granted to any responsible parties who wish to install or have installed a high pressure gas storage system covered by their pending patent application.



Basic unit in underground gas storage system is length of high carbon steel pipe with ends forged to hemispherical shape and tapped for 1½-in. outlet.

• **THE SYSTEM.**—The underground gas storage system developed by Mr. Meiller and Mr. Markle already has been used successfully in installations having a capacity of more than 95,000,000 cu ft of natural gas.

This new type of natural gas storage consists of buried random lengths of 24-in. O.D. seamless, high carbon, alloy steel pipe, average length about 40 ft.

To avoid field welding of this high carbon pipe, both ends of each length of pipe are swedged down and tapped for 1½-in. pipe thread.

• **PRESSURE.**—Many of the costs entering into this type of gas storage, such as the cost of trenching, coating, laying, cathodic protection, land, etc., are independent of the operating pressure; therefore, a high operating pressure obviously results in lower cost per unit of gas stored. The operating pressure selected was 2240 lb per sq in., at which pressure the compressibility factor of natural gas is near the optimum.

Because of the departure of natural gas from the laws of perfect gases, the stored volume of the particular natural gas involved is, at 40F and 2240 lb per sq in., approximately 43% greater than the calculated storage of a perfect gas.

• **COMPRESSIBILITY.**—The compressibility factor becomes more favorable with decreasing temperature; therefore, it is desirable to bury the pipe at a depth which will result in reasonably low temperatures in winter (say about 40F for the Chicago area) and yet minimize seasonal temperature changes. Due to the seasonal temperature changes, some gas must be withdrawn from storage in the spring and summer, and an equivalent amount put back into storage in the fall and winter. At the operating pressure of 2240 lb per sq in., each degree change in temperature will cause a pressure change of about 10 lb per sq in., of which about one-half is due to the change in the compressibility factor.

• **COST.**—The cost of a 40 million cu ft installation at Mount Prospect for Public Service Co. of Northern Illinois was on the order of $45.00 per 1000 cu ft of gas storage capacity for the storage field only. The total cost, including the compressor and sendout station, land, engineering, etc., was on the order of $60.00 to $65.00 per 1000 cu ft of gas storage capacity. When the ultimate storage of 70 million cu ft is installed at this site, it is anticipated that the average cost per 1000 cu ft will be on the order of $55.00.

• **CREDITS.**—Stone & Webster Engineering Corp. engineered and supervised the construction of the Mount

Prospect installation. The special pipe sections were fabricated and supplied by National Tube Co. Contracting & Material Co. of Evanston were contractors for the installation of the special pipe sections.

LEAK DETECTOR

tests 13 miles of copper tube for research project.

A leak detector, so sensitive it can spot Freon gas escaping at a rate slower than 1/100 ounce a year was employed recently to test for leaks in 13 miles of copper tube being used for a special project at the General Electric Research Laboratory.

• **SPECIAL USE.**—According to John S. Hickey, a Research Laboratory engineer, this application of the instrument was necessitated by the laboratory's requirement for a large quantity of copper tube completely free from leaks. The tube, intended for use as a water-cooled conductor to operate in a vacuum chamber, had a ⅛-in. outside diameter with a .015-in. wall. It was obtained in 100-ft lengths and induction brazed into mile-long lengths for use.

• **TEST.**—A mixture of eight parts nitrogen to one part Freon was bled into the tube, while the far end remained open, until samples of the escaping gas were

A G-E Type H leak detector set up to test copper tube being run past "pistol nose" of instrument.

found to contain Freon, as shown by the leak detector. A valve on the end of the tube was then closed and the pressure built up to 600 lb per sq in. The preliminary bleeding of the air was necessary to prevent the far end of the coil from retaining only air.

Except for about five ft at the ends of the coils, which were tested by hand, the actual leak test was conducted by running the tube through a special pick-up at about one ft per second.

In the first test (on 13 miles of tube having approximately 675 joints) seven leaky joints, two porous sections of tube, and three folds were found, according to Mr. Hickey. The leaky joints were poor braze jobs; the porous sections were 100-ft coils that had many leaks per ft over the entire length. The folds apparently were ingot flaws that had closed up during drawing of the tube and were not visible to a casual inspection.

• **FINAL CHECK.**—Each reel was given a final check by putting it, fully charged with gas, into a cardboard box for a week. The box air was then tested for Freon. One reel was found to have a leak. It was re-run on the test bench and a leaky joint found. This joint, Mr. Hickey said, may have cracked when it was wound on the reel after the first test. Subsequent experience with the tube has shown that the G-E Type H leak detector found all the leaks that had existed, he said.

CASE AGAINST LICENSING

is presented by William B. Henderson at forum discussion before refrigeration contractors.

"There can be no disagreement between us on the basic premise that the industry can progress and prosper only by giving the users of the products of our industry the best possible equipment and service at the lowest possible price. The welfare and prosperity of each of us individually is bound up in that basic premise."

Thus William B. Henderson, executive vice president of ACRMA, introduced his argument that legislation requiring licensing (presumably by examination) of new refrigeration contractors while granting licenses without examination to those already doing business is unfair to competition, fosters monopoly, increases costs to customers and adds unnecessarily to taxation. Mr. Henderson presented his views at a forum discussion before the third annual convention of the National Association of Refrigeration Contractors in Chicago, November 19.

"The industry is injured by anything which retards industry progress; which harms or hampers the industry's ability to increase its service to its customers in providing constantly-better equipment at lower prices; or which diminishes individual ingenuity and initiative through agreements—even when such agreements are ratified by municipal ordinance or state law," said Mr. Henderson. "I believe contractor licensing falls within this description. Contractor licensing may provide short-term benefits to a segment of the industry—the contractors—but its long-term effect on the industry as a whole, including the contractors, cannot be other than harmful."

• **INCONSISTENCY.**—"We are all aware that some abuses exist in the industry," Mr. Henderson continued, "NARC has recognized this in published statements, one of which says: 'Unless prevalent abuses and conditions (in the industry) are corrected voluntarily, by the contractors, in conjunction with the other segments of the industry, detrimental and re-

strictive legislation is bound to be passed by city and state governments.' Implicit in this statement is the concept that existing abuses can be corrected voluntarily by contractors, but that if such voluntary correction is not made, 'detrimental and restrictive legislation' is the inevitable result. It seems to me to be a fair interpretation of the NARC statement to say that it reflects the idea that any legislation to correct abuses in this field, where voluntary action is believed to be the real remedy, would be detrimental. Having made this general statement of position, which may have some merit, NARC then takes the completely-inconsistent position of attempting to saddle itself and the industry with detrimental and restrictive legislation at the local and state level."

• **LICENSING FOSTERS MONOPOLIES.**—"My objections to contractor licensing are deeply rooted and stem from my firm conviction that the evils inherent in such legislation are much more dangerous than the abuses sought to be corrected," Mr. Henderson said. "For the purposes of this discussion, I will concede the nobility of purpose promoting legislation of this kind. Such legislation typically states in its preamble: For the protection of the health and safety of the inhabitants of the Blank City, it is deemed necessary to license. . . . My point is—and the experience of other industries from which we should profit will show—that such contractor licensing legislation, whatever its avowed purpose, has often had the effect of

(1) Restricting competition,
(2) Allocating business,
(3) Increasing costs, not infrequently through formal or informal, direct or indirect, price-fixing.

"Actions on the part of contractors which bring about any of those results are, as you well know, violations of the laws of the United States, subjecting the violators to substantial penalty. The anti-trust prosecutions of the Department of Justice and the complaint proceedings of the Federal Trade Commission, against groups of contractors, too numerous to cite, are examples proving the point. Even though the proponents of contractor licensing, seeking to minimize their competitive difficulties through so-called 'remedial legislation,' approach the problem with the most high-minded intent, in practical operation the human element can and does knock altruistic theories into a cocked hat. That 'human element' can rationalize an exhorbitant profit into a 'fair profit'; a competitor who can do a job at least as well at a lower price, a 'chisler'; an examination so stiff or unfair as to discourage prospective competition as 'reasonable and in the public interest'; etc. There are many variations of the reasoning of that 'human element,' much of which could hardly be called 'high-minded' or 'altruistic.' The stern fact is that contractor licensing legislation limits the number who can enter the field, tends to eliminate competition between contractors, and gives existing contractors every incentive by agreement, express or implied, or by concerted action, to fix prices, allocate business, regulate output, and in general to control the market for their services. In brief, it gives existing contractors a monopoly by freeing them from the effects of competition and gives them a weapon which is almost certain to be abused."

Mr. Henderson then illustrated his point by citing examples of how licensing fosters the abuses he described as inherent in monopoly.

• **SOME PRO-LICENSING ARGUMENTS.**—"The proponents of contractor licensing justify their position by arguments and general statements which, while at first appearing impressive, lack proof and, therefore, convictions," Mr. Henderson went on. "For example: Proponents argue that control of contractors is necessary to assure that an installation is safe from an accident or health standpoint and that such control can be made effective only if the state or municipality has power to suspend or revoke contractor licenses.

"There is a complete answer to that argument. In some states, it his been found that the courts are loath to support municipal and state officials attempting to withdraw a license and thus deprive a citizen of his accustomed means of livelihood. It has become generally recognized that, as between inspection laws or ordinances and contractor licensing laws or ordinances, the contractor licensing laws are far less likely to receive the support of the courts in case they are challenged by a contractor. Inspection, particularly state or municipal inspection, can punish a contractor through refusing to approve his work, thus forcing him to remedy the defects of the installation at his own expense before the installation can be used. Such procedure does not deprive the contractor of his source of livelihood, even though it does injure his reputation with customers and gives him a limited set-back he is not likely to forget. Fines or other punishment for violation of inspection laws and ordinances are another customary method of forcing contractors to obey the rules and regulations.

"Further, injunction procedure can always be used against contractors who violate municipal or state inspection laws. This is a simple and inexpensive procedure, compared with the administrative costs of establishing boards to conduct state or municipal examinations and issue licenses.

"In any case, in the course of time, the threat of suspension or revocation of licenses is very likely to lose all meaning, unless that procedure is used with uniformity and without discrimination.

"Because of court decisions, licensing authorities active in other industries have become cautious about the use of the license suspension or revocation procedure. Moreover, probably no one here is so inexperienced in the practical facts of life as to suppose that the license suspension or revocation procedure would be used with consistent impartiality. In brief, inspection laws can provide ample protection for the public interest, they are easier and less expensive to enforce, and they are not nearly so subject to abuse."

Discussing the argument that examination assures competency, Mr. Henderson pointed out that "A man's

competency to direct the installation of equipment cannot be conclusively, or even approximately, determined by an examination. The average contractor is years away from his school days. A written examination could be a nightmare to him, for often he has lost his facility for answering a written examination. An oral, or partially oral, examination could be easy to a glib but incompetent or dishonest contractor, and yet throw a perfectly-competent and honest contractor into tongue-tied confusion."

"Aside from the inadequacy of the examination device," Mr. Henderson stated, "the argument that competency shall be tested by examination is weakened further by the fact that *its proponents are not interested in testing the competency of everyone.*

When contractor licensing ordinances or laws are adopted, it is common practice to issue licenses, without examination, to all contractors then in the business in the area. Perhaps in this practice we glimpse the real reasoning of some proponents of contractor licensing! Existing contractors are admitted to the charmed circle, irrespective of their competency. If it were not so arranged, there would be vigorous opposition to any proposed licensing bill or ordinance."

To those who propose that contractor licensing compares with the licensing of doctors and dentists, Mr. Henderson points out the obvious differences in professional responsibility and the difference in finality of the work done by contractors.

• **SUMMARY.**—"In summation," concluded Mr. Henderson, "I am opposed to contractor licensing in the air conditioning and refrigeration industry because:

(a) Licensing of contractors tends to limit free and competitive enterprise and create barriers to interstate and inter-community commerce . . .

(b) Inherent in contractor licensing is the opportunity for abuses . . .

(c) Contractor licensing opens the door to illegal practices by existing contractors . . .

(d) Licensing charges must be reflected in higher over-all costs of air conditioning and refrigeration installations to the buyer . . .

(e) Contractor licensing will be, as it has been in other businesses, a retarding influence on the growth and progress of our industry . . .

(f) There are alternatives to contractor licensing which are more effective and subject to less abuse. A system of installation permits and inspection, well-conceived and impartially administered, is much to be preferred to contractor licensing from all viewpoints—that of the public, the municipal and state authorities, *and the industry as a whole.*"

• • •

• The snow-melting system under the sidewalks of the Duquesne Club in Pittsburgh features a layer of 800 sq ft of 2-in. *cellular glass insulation under pipes* which are, in turn, embedded in the concrete.

SHIRT-SLEEVES SELLING

for 1949, theme of new General Electric campaign for its distributors and dealers.

Covering the country similarly to the one-stand theatrical road companies, representatives of the air conditioning department, General Electric Co., are holding meetings in key cities for the company's dealers and distributors to bring to them the theme of "back to shirt-sleeves selling."

At the New York City regional meeting held at the Hotel Belmont Plaza, February 18, Harold F. Smiddy, vice president stated, "It was back in 1938 or 1939 that we had our last real experience at a knock-down drag-out selling year—but we've got one in 1949. Let's roll up our sleeves and start selling." The gathering was divided into special meetings of interest to those engaged in selling heating systems, packaged air conditioning, commercial type compressors, large remote air conditioning systems, and refrigerated showcases and boxes.

• **HEATING MARKET.**—The company expects that heating will prove to be a $350 million market in 1949. At present the largest heating market is found in the speculative building program. While 75% of all new homes last year were built by speculative builders, this figure is expected to increase to 80% in 1949. The reason builders do not consider the heating system of a house of major importance is that the customer is not greatly interested in the heating unit or system.

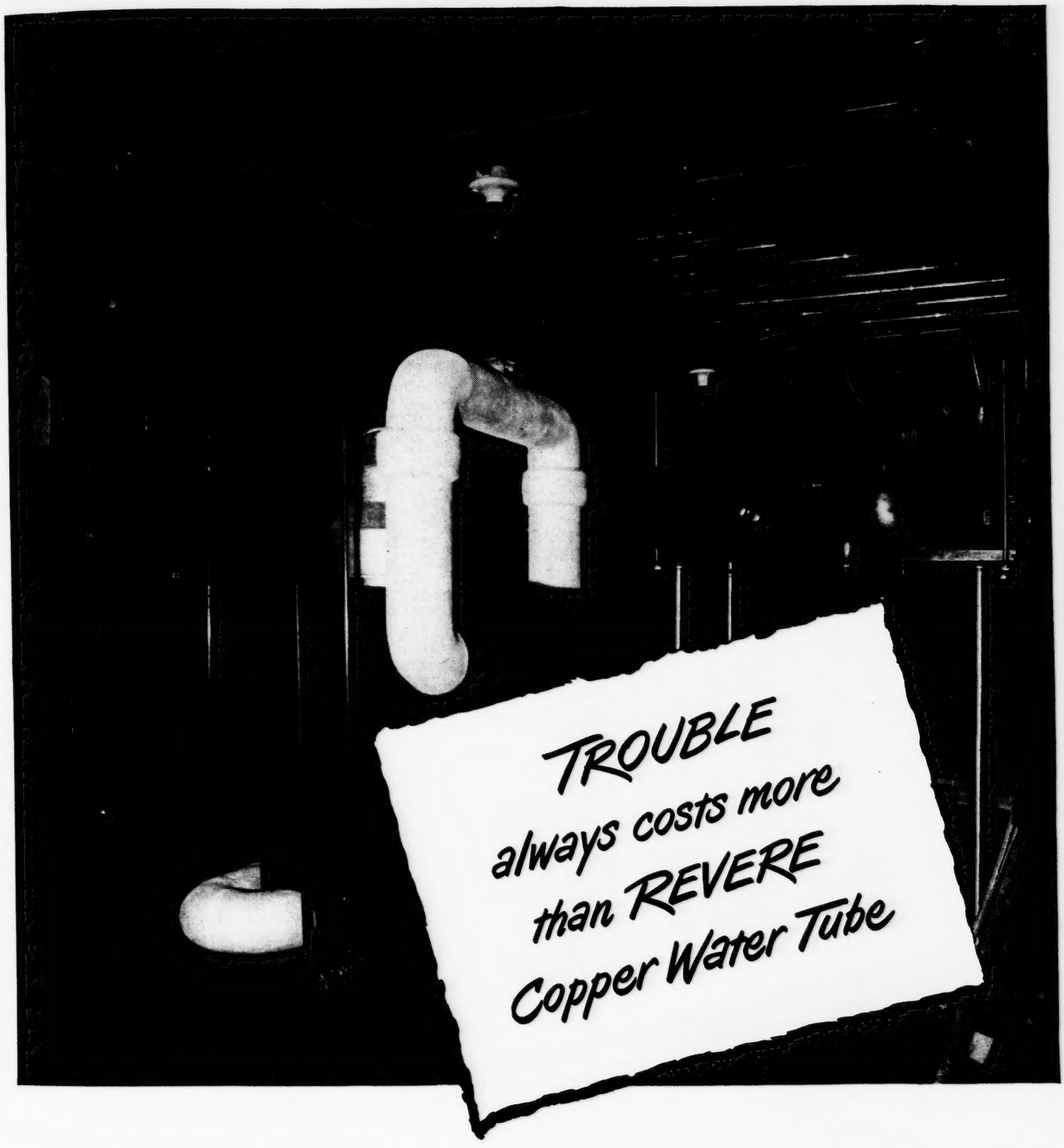
At the heating meeting, considerable emphasis was placed on Air-Wall heating (see page 101) as a means for developing increased heating business.

• **AIR CONDITIONING.**—Market surveys indicate that $84 million will be spent on packaged air conditioning systems. About 80% of this amount will be spent on 3 and 5 hp package units. This group figure in turn, was broken down to show what percentage of this business will come from wearing apparel stores, general business offices, drug stores, taverns and bars.

To the 3 and 5 hp units of last year, G-E has added packaged air conditioners of 2, 7½ and 10 hp.

• • •

• Worthington Pump and Machinery Corp. announced at a New York sales conference, a *new plan for credit aid* to distributors. The plan guarantees authorized Worthington distributors that the manufacturer will back up distributors' credit with local banks when floor stock financing is desired. It assures banks that a Worthington distributor may exercise an option to ask the manufacturer to repurchase an item in inventory within seven months of purchase. The manufacturer guarantees to pay 80% of the sales price. During the eighth and later months, up to twelve, the percentage of the manufacturer's repurchase guarantee drops 10% a month to a base of 30% at the twelfth month and expires at the end of the year.



On every job—whether it calls for hard temper or soft temper tube, or both—you can rely on Revere Copper Water Tube for long years of service and for installation economy.

Revere hard temper tube is furnished in straight lengths of 12 feet and 20 feet. Revere soft temper tube is available in straight lengths or coils. It is readily bent either by hand or by machine.

All Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type. These marks are more than identification—they are your assurance of full wall thickness and the close dimensional tolerances so essential for tight soldered joints.

It will also pay you to install such other long-lived Revere materials as Red-Brass Pipe; Sheet Copper and Herculoy for tanks, ducts, pans and trays; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service is always ready to serve you. Call your Revere Distributor.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

DEGREE-DAYS FOR JANUARY, 1949

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 21st Year of Publication of Monthly Degree-Day Data

City	January			Cumulative, Sept. 1 to Jan. 31			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Abilene, Texas (A)	918	803	326	1868	1808	1251	2061
Albany, New York (A)	1119	1537	1287	3473	4181	3726	6580
Albuquerque, New Mexico (A)	1075	970	924	2968	2818	2751	4298
Alpena, Michigan (C)	1196	1509	1431	3718	4150	4382	8299*
Anaconda, Montana (C)	1871	1293	1321	5337	4480	4492	8357**
Asheville, North Carolina (C)	543	1013	831	2052	2582	2520	4232
Atlanta, Georgia (A)	414	842	682	1420	1960	1813	2890
Atlantic City, New Jersey (C)	730	1107	992	2166	2762	2727	5176
Augusta, Georgia (C)	260	703	555	972	1631	1441	2161
Baker, Oregon (C)	1785	919	1218	4944	3627	4033	7163
Baltimore, Maryland (C)	702	1104	955	2109	2699	2619	4533
Billings, Montana (A)	1729	1119	1318	4546	3883	4134	7119
Binghamton, New York (C)	1013	3073	1268	3257	3823	3783	6808
Birmingham, Alabama (A)	393	875	589	1375	1937	1502	2352
Bismarck, North Dakota (A)	1934	1669	1807	5292	5155	5321	9192
Block Island, Rhode Island (C)	844	1165	1048	2452	3030	2784	5788
Boise, Idaho (A)	1692	993	1097	4306	3358	3382	5552
Boston, Massachusetts (A)	940	1294	1150	2710	3383	3280	6045
Bozeman, Montana (C)	1852	1321	1403	5180	4528	4689	8521**
Buffalo, New York (A)	1045	1443	1240	3164	3745	3612	6822
Burlington, Iowa (A)	1277	1437	(a)	3552	3669	(a)	(a)
Burlington, Vermont (A)	1237	1632	1429	3724	4480	4202	7514
Butte, Montana (C)	1945	1393	1309	5640	4844	4492	8235**
Cairo, Illinois (C)	742	1109	908	2077	2539	2407	3909
Canton, New York (C)	1295	1661	1520	3834	4600	4514	8020
Charleston, South Carolina (C)	207	630	487	647	1306	1119	1769
Charlotte, North Carolina (C)	414	871	725	1447	2138	1945	3120
Chattanooga, Tennessee (A)	477	967	732	1741	2247	1957	3118
Cheyenne, Wyoming (A)	1578	1259	1215	4516	4033	4104	7466
Chicago, Illinois (C)	1080	1377	1190	3048	3466	3362	6077
Cincinnati, Ohio (C)	756	1210	1017	2333	2879	2813	4684
Cleveland, Ohio (A)	934	1391	1181	2984	3515	3366	6155
Columbia, Missouri (C)	1092	1241	1110	2858	2906	3006	4922
Columbia, South Carolina (C)	280	741	586	1043	1719	1502	2364
Columbus, Ohio (C)	855	1324	1113	2675	3240	3133	5398
Concord, New Hampshire (A)	1159	1579	1349	3688	4394	4081	7353
Concordia, Kansas (C)	1419	1207	1184	3481	3190	3203	5315
Dallas, Texas (A)	780	810	617	1612	1743	1487	2256
Davenport, Iowa (C)	1264	1435	1352	3434	3648	3685	6289
Dayton, Ohio (A)	919	1391	1116	2963	3501	3063	5264
Deer Lodge, Montana (C)	1959	1271	1376	5616	4473	4894	8672**
Denver, Colorado (C)	1409	1084	1079	3622	3234	3355	5874
Des Moines, Iowa (C)	1423	1375	1392	3671	3657	3762	6384
Detroit, Michigan (A)	1035	1408	1252	3183	3688	3584	6490
Devils Lake, North Dakota (C)	1999	1838	1949	5614	5693	5820	9970
Dodge City, Kansas (A)	1342	1126	1116	3378	3102	3068	5035
Dubuque, Iowa (C)	1336	1514	1442	3729	3928	3976	6790
Duluth, Minnesota (C)	1579	1808	1727	4706	5292	5216	9483
Eastport, Maine (C)	1201	1438	1380	3734	4109	4270	8520**
Elkins, West Virginia (A)	758	1343	1048	2927	3528	3265	5697
El Paso, Texas (A)	899	758	629	2048	1946	1667	2428
Ely, Nevada (A)	1836	1125	(a)	5176	4188	(a)	(a)
Erie, Pennsylvania (C)	929	1324	1172	2831	3362	3336	6273
Escanaba, Michigan (C)	1337	1640	1550	4062	4464	4688	8771
Evansville, Indiana (A)	807	1230	949	2450	2964	2494	4244
Fort Smith, Arkansas (A)	827	979	850	2094	2193	2027	3147
Fort Wayne, Indiana (A)	1028	1449	1194	3250	3760	3405	5925
Fort Worth, Texas (A)	806	826	580	1602	1760	1406	2148
Fresno, California (A)	785	426	583	1868	1538	1494	2334
Galveston, Texas (C)	352	540	353	637	948	683	1016
Grand Junction, Colorado (A)	1428	1227	1233	3890	3585	3511	5548
Grand Rapids, Michigan (C)	1075	1395	1262	3256	3650	3659	6535
Green Bay, Wisconsin (C)	1365	1674	1538	4043	4451	4420	7825
Greensboro, North Carolina (A)	536	979	772	1931	2531	2167	3529
Greenville, South Carolina (A)	444	897	744	1558	2144	2078	3380
Harrisburg, Pennsylvania (A)	873	1282	1088	2781	3254	3069	5375
Hartford, Connecticut (A)	963	1396	1159	3033	3705	3316	6036
Hatteras, North Carolina (C)	395	718	589	1009	1492	1316	2571
Havre, Montana (C)	1911	1166	1624	5240	4217	4938	8700
Helena, Montana (A)	1998	1235	1375	5457	4324	4433	7894**
Houston, Texas (C)	420	574	366	809	1053	815	1157
Huron, South Dakota (A)	1776	1652	1650	4733	4823	4735	8004
Indianapolis, Indiana (A)	958	1305	1128	2994	3245	3130	5298
Jackson, Mississippi (A)	372	789	(a)	1120	1604	(a)	(a)
Kansas City, Missouri (A)	1214	1235	1141	2935	2960	3007	4956
Knoxville, Tennessee (A)	513	1003	815	1870	2343	2298	3670
La Crosse, Wisconsin (A)	1473	1676	1535	4232	4629	4313	7322
Lander, Wyoming (A)	1975	1412	1436	1412	4503	4511	7947

(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 114]

G-E flight test hangar at Schenectady, N. Y., used for maintenance, testing and development. Marcus T. Reynolds, architect; Heating Maintenance Corp., heating contractors.

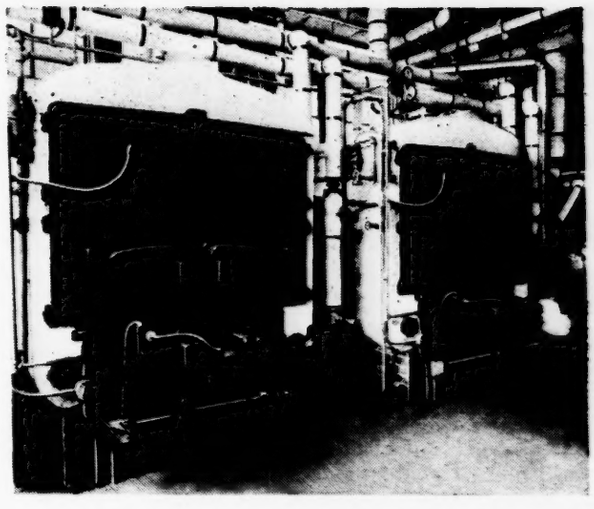
How to heat almost an acre of hangar

Heating the mammoth General Electric flight test hangar at Schenectady, N. Y., presented — as it always does in buildings of this type — the serious problem of how to maintain reasonably uniform temperatures despite very high ceilings and frequent air changes due to the opening and closing of hangar doors.

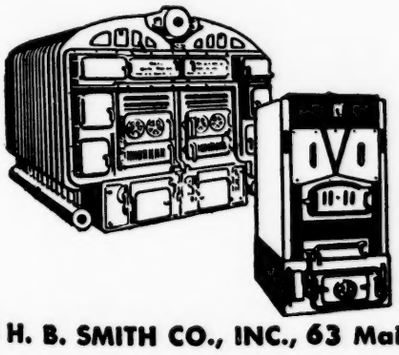
Consulting Engineer J. L. Ottenheimer solved the problem by specifying a radiant heating system installed in the concrete floor to maintain a comfortable temperature which is recovered unusually fast after hangar doors have been open. In spite of the 45-foot ceiling, a breathline temperature of only 60° has proved comfortable, and ceiling temperature is actually 2° lower, representing a considerable saving in fuel.

Two H. B. Smith No. 440 cast-iron sectional boilers heat the radiant floor panels in a manner which engineers have come to expect from these proved and tested Smith products. Their efficiency with heavy-oil, flexibility, and economy contribute much to any heating system. Their negligible maintenance costs, easy installation, and long-life expectancy should be considered no matter what the size of the job.

H. B. Smith boilers are being selected more and more for the difficult heating jobs where only the *best* equipment will do.



Two H. B. Smith No. 440 Mills water tube boilers, fired by heavy-oil burners, furnish steam for the heat exchanger from which water is circulated to the panels.



H.B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., 63 Main St., Westfield, Mass., Offices and Representatives in Principal Cities

Degree-Days for January, 1949 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 21st Year of Publication of Monthly Degree-Day Data

City	January			Cumulative, Sept. 1 to Jan. 31			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Lansing, Michigan (A)	1142	1499	1336	3514	4015	4001	7048
Lewiston, Maine (O)	1199	1534	1452	3578	4224	4289	7707
Lincoln, Nebraska (C)	1503	1332	1311	3786	3528	3512	5999
Little Rock, Arkansas (A)	671	929	719	1808	2066	1798	2811
Livingston, Montana (C)	1656	1176	1220	4526	4028	3951	7245**
Los Angeles, California (C)	562	219	326	1072	676	750	1504
Louisville, Kentucky (A)	726	1181	939	2314	2750	2526	4180
Lynchburg, Virginia (A)	619	1042	856	2158	2727	2413	3980
Macon, Georgia (C)	288	709	549	1084	1670	1446	2201
Madison, Wisconsin (C)	1356	1604	1500	3858	4291	4258	7429
Marquette, Michigan (C)	1302	1579	1500	4079	4488	4554	8693*
Memphis, Tennessee (A)	603	1015	744	1770	2180	1871	2950
Meridian, Mississippi (C)	317	794	552	1106	1645	1435	2160
Milwaukee, Wisconsin (A)	1225	1546	1383	3609	4047	3984	7245
Minneapolis, Minnesota (A)	1579	1697	1609	4358	4728	4550	7850
Montgomery, Alabama (C)	274	717	515	914	1472	1284	1884
Nantucket, Massachusetts (A)	877	1154	1026	2686	3224	2938	5957
Nashville, Tennessee (A)	571	1101	812	1899	2439	2175	3507
New Haven, Connecticut (A)	911	1306	1110	2809	3463	3219	5895
New Orleans, Louisiana (C)	183	542	332	599	1018	735	1024
New York, New York (C)	807	1211	1028	2312	3015	2884	5274***
Nome, Alaska† (A)	(a)	1775	1857	(a)	5192	5236	14580**
Norfolk, Virginia (C)	472	895	738	1425	2041	1933	3350
North Head, Washington (C)	927	661	725	2892	2320	2510	5452**
North Platte, Nebraska (C)	1656	1185	1300	4149	3549	3786	6366
Oakland, California (A)	726	438	527	1959	1584	1626	3143**
Oklahoma City, Oklahoma (C)	1069	1007	865	2339	2309	2244	3613
Omaha, Nebraska (A)	1483	1393	1355	3774	3654	3639	6131
Oswego, New York (C)	1109	1420	1277	3272	3787	3771	7088
Parkersburg, W. Virginia (C)	735	1257	992	2482	3031	2822	4775
Peoria, Illinois (A)	1191	1390	1283	3332	3558	3606	6109
Philadelphia, Pennsylvania (C)	760	1169	962	2225	2857	2661	4737***
Phoenix, Arizona (C)	630	357	409	1293	1055	990	1405
Pittsburgh, Pennsylvania (C)	771	1343	1054	2550	3378	3003	5235
Pocatello, Idaho (A)	1866	1197	1218	4813	3959	3867	6655
Portland, Maine (A)	1188	1531	1321	3640	4083	3926	7218
Portland, Oregon (C)	1066	725	806	2882	2187	2530	4469
Providence, Rhode Island (C)	889	1260	1116	2650	3302	3246	6015
Pueblo, Colorado (A)	1382	1168	1060	3661	3400	3224	5514
Raleigh, North Carolina (C)	460	911	722	1515	2223	1975	3234
Rapid City, South Dakota (A)	1739	1226	1320	4489	3883	4021	7118
Reading, Pennsylvania (C)	817	1250	1088	2535	3114	3102	5389
Red Bluff, California (A)	793	454	(a)	1947	1597	(a)	(a)
Reno, Nevada (A)	1576	902	1042	4158	3347	3326	5892
Richmond, Virginia (C)	577	1012	831	1833	2505	2211	3695
Rochester, New York (A)	1077	1442	1252	3302	3832	3666	6732
Roseburg, Oregon (C)	(a)	775	744	(a)	2299	2485	4428
Roswell, New Mexico (A)	1139	972	786	2645	2517	2296	3484
Sacramento, California (C)	792	468	614	1934	1600	1610	2653
St. Joseph, Missouri (A)	1306	1302	1187	3287	3226	3147	5161
St. Louis, Missouri (C)	966	1187	1060	2539	2833	2798	4585
Salt Lake City, Utah (A)	1659	1084	1110	4248	3453	3259	5555
San Antonio, Texas (A)	580	604	381	1160	1233	854	1202
San Diego, California (A)	532	297	332	1093	790	819	1645
Sandusky, Ohio (C)	929	1351	1181	2908	3425	3323	6208
San Francisco, California (C)	632	312	465	1734	1285	1414	3264**
Sault Ste. Marie, Michigan (A)	1447	1716	1581	4390	4803	4828	9285**
Savannah, Georgia (A)	199	584	409	644	1227	1007	1490
Scranton, Pennsylvania (C)	968	1398	1172	3033	3642	3446	6129
Seattle, Washington (C)	975	731	781	2955	2370	2650	4934**
Sheridan, Wyoming (A)	(a)	1232	1431	(a)	4119	4629	8008
Shreveport, Louisiana (A)	536	804	555	1333	1646	1324	1938
Sioux City, Iowa (A)	1606	1463	1435	4305	4090	4018	6898
Spokane, Washington (A)	1751	1162	1172	4792	3764	3755	6355
Springfield, Illinois (C)	1073	1255	1181	2898	3128	3183	5373
Springfield, Missouri (A)	1025	1185	973	2732	2808	2647	4428
Syracuse, New York (A)	1096	1470	1277	3329	3947	3768	6893
Tacoma, Washington (C)	1024	794	812	3137	2595	2763	5181**
Terre Haute, Indiana (A)	956	1333	1070	2901	3352	2910	4872
Toledo, Ohio (A)	999	1428	1203	3207	3745	3392	6077
Topeka, Kansas (C)	1265	1224	1135	3029	3012	3018	4969
Trenton, New Jersey (C)	796	1225	1014	2448	3093	2774	4933
Utica, New York (O)	1099	1525	1248	3200	4113	3785	6796
Valentine, Nebraska (C)	1751	1320	1370	4500	3975	4095	7039
Walla Walla, Washington (C)	1476	931	989	3663	2770	2898	4808
Washington, D. C. (C)	674	1110	970	2131	2727	2711	4626
Wichita, Kansas (A)	1280	1148	1094	2985	2825	2877	4673
Williston, North Dakota (C)	1982	1550	1805	5400	4898	5463	9323
Winnemucca, Nevada (C)	1734	949	1150	4428	3546	3739	6427**
Yakima, Washington (A)	1564	1049	1159	4318	3291	3587	5599

(a) Data not available.
† Nome data are for December.

* Includes August.
** Includes July and August.
*** New 48-year normal covering 1898 to 1946.

[1] Figures in this column are normal totals for a complete heating season, September to June, incl.

Fast to work... slow to rust

Beth-Cu-Loy GALVANIZED Steel Sheets

In selecting steel sheets your first consideration is their workability. Can they be formed smoothly, cut readily and soldered easily to do a top-grade job in the shortest possible time? With Beth-Cu-Loy Galvanized Sheets the answer is yes. Sheet-metal contractors find in them the uniformity and ductility needed for clean, rapid work.

Your next concern in selecting sheets is their resistance to rust. Home owners and other customers expect sheet-metal work to stand up well against corrosion. Give them jobs that last and you get customer goodwill in return.

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Bethlehem Steel Company, Bethlehem, Pa.

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★ BETHLEHEM STEEL ★

NEW CATALOGS

Insulation Adhesives Reference Manual

An illustrated reference manual on sealers, surface coatings, cements, mastics, emulsions, and other adhesives for use with various types of insulation in both industrial and marine application. Basic properties including viscosity, coverage, flammability, heat flow and resistance to acids and alkalies are discussed for each product. The reference chart summarizes bonding and drying times, colors, temperature limits, types of thinner, and application data for each type.—*Benjamin Foster Co., 4609 W. Girard Avenue, Philadelphia 31, Pa.* 40

Pressure Drop Chart

A chart to facilitate selection of steam separators for given conditions shows correct size and type of separators and pressure drop through equipment. Included on the chart is a method for determining pressure drop on an oil separator for an exhaust steam line. Scales include saturated steam flow in thousands of pounds per hour, superheat scale, pressure drop scale for live steam, and pressure drop scale for exhaust steam.—*Wright-Austin Co., 315 W. Woodbridge St., Detroit 26, Mich.* 41

Shutters and Penthouses

Wing shutters, both manual and automatic, and penthouses for ventilation direct through roofs are described and illustrated in a 4-page bulletin.—*L. J. Wing Manufacturing Co., 154 West 14th St., New York 11, N. Y.* 42

Fans

Two illustrated catalogs, No. 863 and No. 864, describe residential and industrial fans, respectively. Specifications, dimensions, and photographs cover seventeen types of ventilating equipment varying in size from 12 to 60 in. and in output from 1,000 to 32,000 cfm.—*Chelsea Fan & Blower Co., Inc., 1206 Grove Street, Irvington 11, N. J.* 43

Heating Elements

Paracoil Heating Elements are described in Bulletin No. 20 with capacity and dimension tables and installation instructions. Conversion tables are included for various conditions whereby the capacity of any size heating element, not otherwise shown, can be determined.—*Davis Engineering Corp., 1064 E. Grand St., Elizabeth 4, N. J.* 44

Oil Burner Instruction Manuals

Two 80-page manuals give instructions for selection, installation, and maintenance of domestic and industrial oil burners, respectively. Combustion data, selection charts, equipment diagrams, chimney construction, heating survey forms, wiring diagrams, and general service suggestions are included.—*Petroleum Heat and Power Co., Stamford, Conn.* 45

Federal Boilers

Federal boilers for hot water or steam heating systems are described in a 6-page bulletin. Sizes are rated from 19 to 129 square feet of heating surface and models include domestic hot water jacket.—*Federal Boiler Co., Inc., Granite & West Sts., Midland Park, N. J.* 46

Protective Coatings

Bulletin 1540 describes Apexior Number 3, industrial protective coating, and its application to drinking and other water storage tanks, refrigerant condensers and air conditioning equipment.—*The Dampney Company of America, Hyde Park, Boston 36, Mass.* 47

V-Belt Drives

A 100-page manual to assist engineers in designing both multiple and light duty V-belt drives contains drive tables for multiple belts; sheave data including construction, dimensions, and weights; fractional horsepower drive layouts; comparison tables with information on quarter turn drives and hexagon double V-drives.—*United States Rubber Co., Rockefeller Center, New York 20, N. Y.* 48

Handbook of "U" Values

Both winter and summer heat transmission coefficients, "U" values, are compiled in a 108-page book. Coefficients were calculated in accordance with FHA procedure. Drawings show typical wall, floor and ceiling sections and illustrate proper position of insulation. Summer and winter values for ceilings show effect of reflective insulation in checking downward heat flow in summer. Book lists 12,852 "U" values covering all types of standard construction and various combinations of insulation.—*Silvercote Products, Inc., 161 E. Erie Street, Chicago 11, Ill.* 49

Welding Fittings

Catalog 501 is a loose-leaf binder describing welded elbows, return bends, etc., with sizing tables and prices.—*Globe Steel Tubes Co., 3839 W. Burnham, Milwaukee 4, Wis.* 50

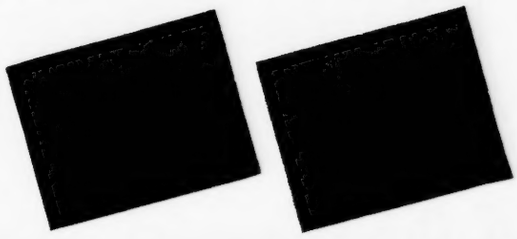
A-C Motor Starters

The Allis-Chalmers line of full voltage a-c starters to meet the requirements of any type of motor drive is described in a new 12-page bulletin, No. 14B7132. Construction features and uses of manual and magnetic across-the-line starters, across-the-line combination starters, reversing starters, and push-button control stations are described and illustrated.—*Allis-Chalmers Mfg. Co., S. 70th St., Milwaukee, Wis.* 51

Radiator Data

A pocket manual provides plumbers and steam-fitters with dimensions, capacities, ratings, and roughing-in data on both current and obsolete types of National cast-iron radiators. — *The National Radiator Co., Johnstown, Pa.* 52

HAMMERED FINISHES IN



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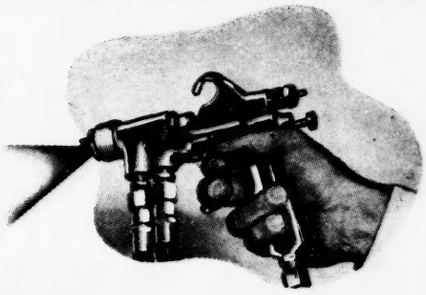

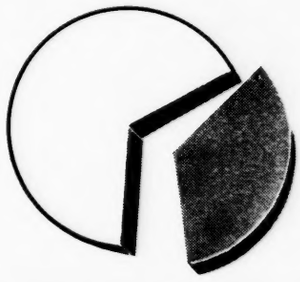

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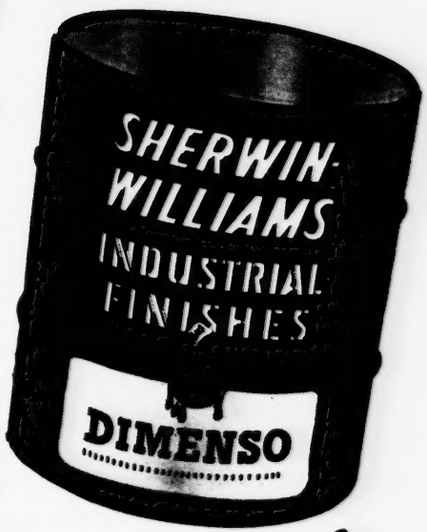

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Registers and Grilles

A 64-page catalog describes and illustrates registers and grilles for warm air heating and air conditioning installations. Adjustable and directional flow registers are included with selection charts and price lists.—*United States Register Co., Battle Creek, Mich.* **53**

Compressor Selection Chart

A selection chart for Worthington HB single horizontal compressors is included in a 4-page folder. Chart is based on normal applications handling air with atmospheric intake pressure and shows recommended compressor bore and stroke in inches.—*Worthington Pump and Machinery Corporation, Harrison, N. J.* **54**

Conversion Gas Burner

A 20-page brochure illustrates and describes the Whirl-Heat conversion gas burner. Shown are eighteen features, including Kindl-Aire combustion and various control developments.—*Kindl-Aire Corporation, 1493 W. 112th St., Cleveland 2, Ohio.* **55**

Automatic Defrosting System

An automatic hot gas defrosting system is described in a 4-page, 4-color bulletin No. DF-100. System is based on the Patterson slug eliminator and diagrams show operation at various stages in the defrosting cycle.—*The Patterson-Kelley Company, Inc., 101 Park Ave., New York 17, N. Y.* **56**

NAFM Standards

To assist the public in the use of terminology and the general functions of various types of fans, Bulletin 108 illustrates and describes air moving equipment. Material is arranged in tabular form.—*National Association of Fan Manufacturers, 5-157 General Motors Bldg., Detroit 2, Mich.* **57**

Petroleum Product Pumps

A 12-page bulletin, No. PM48, describes a new type of centrifugal pump combining centrifugal action with positive self-priming and self-purging. Tables show pumping properties of different petroleum products.—*Marlow Pumps, Ridgewood, N. J.* **58**

MARCH, 1949

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, circle on the list below the publication wanted, using item number at the end of each review. Print your name and address, mail to

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54	55	56	57	58		

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Getting Personal

W. B. Leighton

W. B. Leighton *(Solvent Recovery Cuts Roto Ink Loss,* page 61) received his B.S. in Chemical Engineering from Yale University in 1936. Following graduation he became associated with Carbide and Carbon Chemicals Corp., and has been with them ever since. Following a 1½-year training period in chemical production at South Charleston, W. Va., he started his present work in 1938 with the Special Products Division.

Mr. Leighton is engaged in the design, sale and supervision of installation and initial operation of complete solvent recovery plants employing activated carbon as the recovery medium. Work also includes technical service in connection with existing recovery plants, solvent loss surveys, and pilot test plants for developing new activated carbon applications.

He is a member of the American Institute of Chemical Engineers and the American Chemical Society.

H. J. Bartlett

H. J. Bartlett *(Check Valves in Piping,* page 79) is a native Chicagoan and a good poker player. He is a graduate of Armour Institute of Technology (B.S. in M.E., 1915), and has been with Crane Co. since 1916. His first task was as a piping engineer designing piping layouts for the new Crane Corwith plant in Chicago. Mr. Bartlett was transferred to sales engineering in 1919. He spent several years in working with the paper industry, food industry and with steam power plant specialties, then nine years in railroad sales. In 1931 he was assigned a sales engineering post in chemical processing and food industry sales, and in 1941 he was elevated to his present position as manager of alloy sales.

Edward Wittschiebe

Edward Wittschiebe *(Cleaning of Air Conditioning Equipment,* page 67), a native New Yorker, has been associated with Oakite Products, Inc., for twelve years. A graduate of New York University, he has specialized in sales promotion and in recent years has prepared many feature articles for trade publications and for Oakite News Service—a pioneer publication in the house magazine field. In this article, Mr. Wittschiebe outlines the cleaning problems connected with air conditioning maintenance.

Charles P. Stolberg *(Heating Today's Industrial Plant,* page 69) received his degree in civil engineering from Cornell University and, after brief intervals of engineering for various railroads, joined Gibbs & Hill as engineer and designer of railroad electrification. His next appointment was with Tenney Engineering Company as assistant chief engineer on design and manufacture of special heating, ventilating and air conditioning equipment. After a year with the Austin Company as mechanical engineer on the design of industrial plants, Mr. Stolberg joined the H. K. Ferguson Company nine years ago and served successively as mechanical engineer, project manager, and department head. He is now chief mechanical engineer for the Cleveland district with 140 designers and engineers under his supervision.

Ready for You!

The New KENNARD AIR CONDITIONING UNIT CATALOG

Just off the press . . . It's the air conditioning engineers' "Best Friend". A bulletin, graphically portraying the many unique design and construction features of merit—such as "PENTA-POST" frame construction – qualifying these new Units as worthy additions to the family of Kennard Engineered QUALITY Heat Transfer Products. For both comfort and industrial air conditioning applications – any refrigerating media. Write for your copy today.

COMING SOON!

The New Kennard Evaporative Condenser Catalog will shortly be available. Send us your request now . . . we'll put you on our list for *Rush Delivery*.

QUALITY IN COILS

One-piece fins . . . Non-Corrosive frames . . . Hydraulic Tube-Fin bond with 3000 psi . . . cleaner inside surfaces. The foregoing are but a few of the fabrication features that have earned for KENNARD COILS the reputation of higher quality . . . reliable performance . . . proved economy. Send for Kennard Catalog 47A-(Finned Coils)

"Refinement of Detail Marks the Difference Between Ordinary and Excellent."

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. . . Since the Last Issue

W. H. Magee has been appointed general sales manager of **Russell Electric Co.**, Chicago, subsidiary of **Raytheon Manufacturing Co.** During the past four years Mr. Magee was Midwest sales manager of U. S. Gauge Co. Division of American Machine and Metals, Inc., with offices in Chicago. Previously, he served as Chief of Pressure Instruments on the War Production Board in Washington from 1942 to 1944. Russell Electric manufactures fractional horsepower motors.

Two new executive appointments have been announced by the **Perfex Corp.**, Milwaukee, manufacturers of automatic heating controls and industrial radiators. Vice president **Allen Butler** has been named assistant to the president, while **V. P. Black,** formerly manager of advertising, sales promotion and sales training for the Airtemp Division of the Chrysler Corp., has been newly appointed a vice president to fill the vacancy left by Mr. Butler, as manager of the Controls Division. Mr. Butler joined Perfex in 1935, handling advertising and sales promotion. In 1936

V. P. Black

A. Butler

he became manager of the Perfex Chicago office in charge of sales throughout the Midwest. In 1945 he became a vice president and in 1947 he was named manager of the Controls Division. In his new position he will handle sales contact for the corporation at the executive level and will act as Perfex representative in various association activities. Mr. Black, a graduate of Ohio University in 1926 and a member of the Delta Tau Delta fraternity, was first employed as a research chemist for the Frigidaire Division of General Motors, where he made some of the earliest installations using Freon-12 refrigerant. From 1935 until the Perfex appointment he had been with Chrysler Corp., Airtemp Division, in various executive capacities.

Appointment of **F. J. Van Poppelen** as manager of manufacturing of the **General Electric Co.'s Air Conditioning Department,** has been announced. Mr. Van Poppelen succeeds Mr. A. W. Wennerstrom, who, after more than thirty-five years with the company, is taking up new duties as manufacturing consultant on the Air Conditioning Department manufacturing staff.

Promotion of **J. H. Swallow** to the position of southern district sales manager of the **Bryant Heater Co.** has been announced. Mr. Swallow has served as branch manager of the Bryant St. Louis office for the past three years.

Appointment of **Frank A. Mitchell** as sales manager of the **Unit Air Conditioner Division** of the **Fedders-Quigan Corp.** has been announced. Mr. Mitchell succeeds E. A. Bonneville, who recently resigned. Mr. Mitchell was formerly sales manager of the Deepfreeze Corp., and also was with the Washing Machine Division of Bendix.

C. G. Smith

C. G. Smith, formerly sales manager of **Davis Engineering Corp.,** has rejoined that company in the capacity of sales promotion manager with headquarters at the main office, Elizabeth, New Jersey. R. Lisson will continue in the position of sales manager. In the interval Mr. Smith has served as sales manager for Simplex Oil Heating Corp., New York; chief engineer for Gielow, Inc., naval architects and marine engineers, New York; chief engineer, Shipbuilding Division, Consolidated Steel Corp., and as district manager (N. Y.) for Enterprise Engine Co., San Francisco, California Currently, Mr. Smith resigned as chief engineer, H. Newton Whittelsey, Inc., naval architects and marine engineers.

Dr. G. V. Slottman has been appointed director of research and engineering for **Air Reduction Co.** Dr. Slottman, who joined Air Reduction in 1934, served as manager, technical sales division and, on January 1st, 1948, was appointed technical assistant to the vice president in charge of sales, a position he held until his recent appointment. He has been closely associated with Air Reduction's development and introduction of steel-making processes using large quantity, low-purity oxygen for both combustion purposes and as a chemical reagent. He has also written for publication a number of articles on these topics. A native New Yorker, Dr. Slottman was graduated from Massachusetts Institute of Technology in 1925. In 1927 he received his Ph.D. from the University of Berlin and returned ot M.I.T. as a professor of chemical engineering.

Acquisition of the business, plant and all facilities of the **D. T. Williams Valve Co.,** Cincinnati, manufacturers of high-pressure valves was disclosed by **The Schaible Co.,** producers of low compression valves and plumbing and heating equipment.

R. W. Murphey has been designated advertising manager, **Taylor Forge & Pipe Works,** whose general offices and main plant are located in Chicago. The company also operates an eastern plant at Carnegie, Pa., and a western plant at Fontana, Calif. Mr. Murphey has had extensive industrial advertising experience, and is well known in the Chicago area.

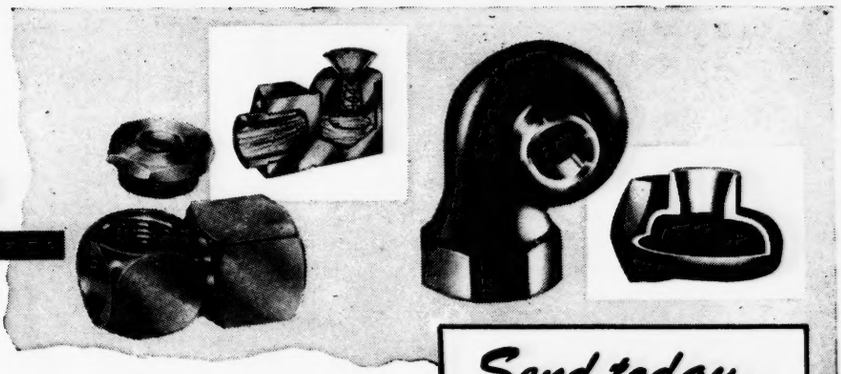
Appointment of **Frederick P. Combier** as sales manager and **Robert C. Cassidy** as chief engineer for Uskon electrical heating panels has been announced by the wire and cable department, **United States Rubber Co.** Both men will make their headquarters in the company's New York offices at 1230 Avenue of the Americas.

The Philip Carey Mfg. Co., Cincinnati, Ohio, has announced that **J. J. Smiley, Jr.** has been appointed commodity manager for the sale of Miami Carey fans.

H. L. Murray

Minneapolis-Honeywell Regulator Co. has announced that it has entered an agreement for the acquisition of the assets of the **H. Belfield Co.,** manufacturer of control valves. Harold W. Sweatt, Honeywell president, said that **Howard L. Murray,** president of Belfield, would be elected a vice president of Minneapolis-Honeywell and would be in charge of the new acquisition which will be known as the **Belfield Valve Division** of Minneapolis-Honeywell. The Belfield company, occupying a five-story building in Philadelphia, manufactures certain types of automatic control valves not previously made by the Honeywell company. All personnel of Belfield will continue with the company in their same capacities.

Only 7 lbs. pressure provides FINE, UNIFORM BREAK-UP AND DISTRIBUTION OF FLUID



with Binks ROTOJET clog-proof spray nozzles

Absence of internal vanes and obstructions permits maximum spraying efficiency at extremely low pressures with Binks Rotojet Spray Nozzles. Designed on the off-center inlet, whirl chamber principle for greatest spraying effectiveness. Sizes up to ¾" pipe connection are of two-piece construction, precision-machined from finest quality brass bar stock, stainless steel or any special alloy that is machinable from bar stock. Sizes from 1" to 2½" have strong cast one-piece bodies. Wide capacity range.

Send today **for technical bulletin describing Binks ROTOJET Nozzles**

Bulletins give full information on sizes and capacities of the following Binks Rotojet Nozzles:
Bulletin Numbers:

10. Small and Medium Capacity Nozzles
11. Nozzles for Brine Spray Operation
12. Large Capacity Nozzles
13. Nozzles for Spray Ponds
14. Nozzles for Metal Cleaning Operations.

Please state how nozzles will be used, giving installation capacity.

THERE'S A BINKS SPRAY NOZZLE FOR EVERY SPRAY JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3120-38 CARROLL AVENUE, CHICAGO 12, ILL.

You Benefit from

AEROFIN'S Unequaled Experience in Design and Manufacture of FIN-TYPE Heat Exchangers

For over 26 years, Aerofin — pioneer manufacturer of fin-type heat-transfer surface — has been accumulating an unequalled experience in the design and fabrication of heat exchangers. For the right design, materials and construction — for accuracy and efficiency — put your heat-transfer problems up to Aerofin.

AEROFIN is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

Highly skilled workers—continuous research—rigid specifications and tests—all combine to insure the efficiency and dependability of your Aerofin units.

AEROFIN CORPORATION

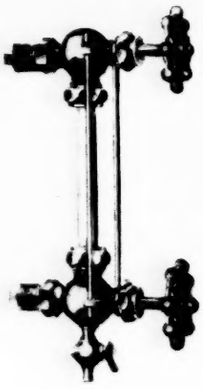
410 South Geddes St., SYRACUSE 1, N. Y.

NEW YORK • CHICAGO • CLEVELAND • DETROIT • PHILADELPHIA • DALLAS • SAN FRANCISCO • MONTREAL

FOR BETTER WATER GAUGES

USE *Roberts*

- **SOLID BRASS**
- **SELF-CLEANING**
- **FOR WORKING PRESSURES Up To 175 POUNDS**



For decades Roberts Water Gauges have been a standard of quality wherever tubular glass gauges are used.

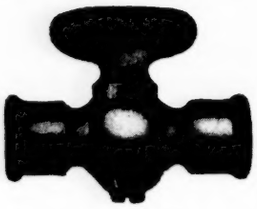
Modern design—made of solid brass with plenty of strength. Self-cleaning feature keeps lower part of gauge from clogging with scale. Special packing allows free expansion of glass, avoiding breakage.

COMPRESSION GAUGE COCKS

Solid brass, durable, with seats that stand long use. Model shown has stuffing box.

Also offered in light pattern less stuffing box.

AIR COCKS—STEAM GAUGE COCKS



Roberts makes air cocks of all types and steam gauge cocks for pressure gauges.

All sizes – 1/8" up to 1/2".

Write for information on Roberts Gauges and Cocks.

THE ROBERTS BRASS MANUFACTURING CO.

Manufacturers of Brass Goods for Steam, Water, Gas and Air

5435 WEST FORT ST. • DETROIT 9, MICH.

Pro-Therm is the trade name under which **Thermo-Products, Inc.**, of North Judson, Ind., is now merchandising automatic heating equipment. The Pro-Therm line includes several types of oil-burning floor furnaces having approximately 50,000 Btu capacities, Hi-Boy and Lo-Boy vaporizing type oil furnaces, and oil-fired domestic water heaters in two sizes. In the past, Thermo-Products, Inc., has produced similar products for other manufacturers to be sold under their trade names.

The **Auer Register Co.**, 3608 Payne Avenue, Cleveland 14, Ohio, manufacturers of registers and grilles for heating and air conditioning, announces the appointment as sales representative for the Chicago territory of **F. Joseph Butler**, 263 Cornwall Drive, Crete, Ill. Mr. Butler is a graduate of the University of Notre Dame, took postgraduate work at Chicago University, was formerly vice president in charge of public relations for the Chicago Stock Exchange, and has had experience in banking and other capacities.

C. E. Scott

C. E. Scott has been appointed manager of the unit heater and convector division of **United States Radiator Corp.** Mr. Scott formerly was vice president of sales and advertising for Rittling Corp., Buffalo, manufacturers of heat transfer products. Prior to that he was manager of the industrial heating and commercial refrigeration divisions of Fedders Manufacturing Corp., Buffalo; manager of the unit heater and air conditioning department of Warren Webster & Co., Camden, N. J., and a sales official of Carrier Corp. at Newark, N. J. During the war he served as a member of three industry advisory committees.

O. B. Wilson, eastern regional sales manager for **Brown Instruments** division of **Minneapolis-Honeywell Regulator Co.** has been named manager of sales for the east, southeast and central regions. Mr. Wilson, who has been with the industrial instruments division of Honeywell for the past 25 years, will supervise sales in the area extending from Florida and the Gulf of Mexico to the Canadian border. He will make his headquarters at the Brown plant in Philadelphia.

Appointment of **George V. Hunter** as advertising manager of the **Radiator Specialty Co.**, Charlotte, N. C., has been announced. Mr. Hunter joins Radiator Specialty Company after three years as promotion manager of *The Charlotte News*. He was formerly research manager of Tracy Locke Dawson, Inc., New York advertising agency; assistant to the promotion manager of *The Washington Post*, and is a veteran of 43 months service with the Army Air Forces. He is a native of Scarsdale, N. Y., married, and attended New York University.

The Eagle-Picher Co. has announced the appointment of **Dr. A. Paul Thompson** as director of research. Dr. Thompson fills the position left vacant by the death of Earle W. McMullen. Widely known in the fields of chemical, ceramic and metallurgical research, Dr. Thompson comes to Eagle-Picher from the Mellon Institute of Industrial Research where he has held a Senior Fellowship since 1932. Prior to that time he was associated with the International Nickel Company of Canada, with the General Chemical Company of New York as research engineer and consultant, and with the Anaconda Copper Mining Company as chief chemist.

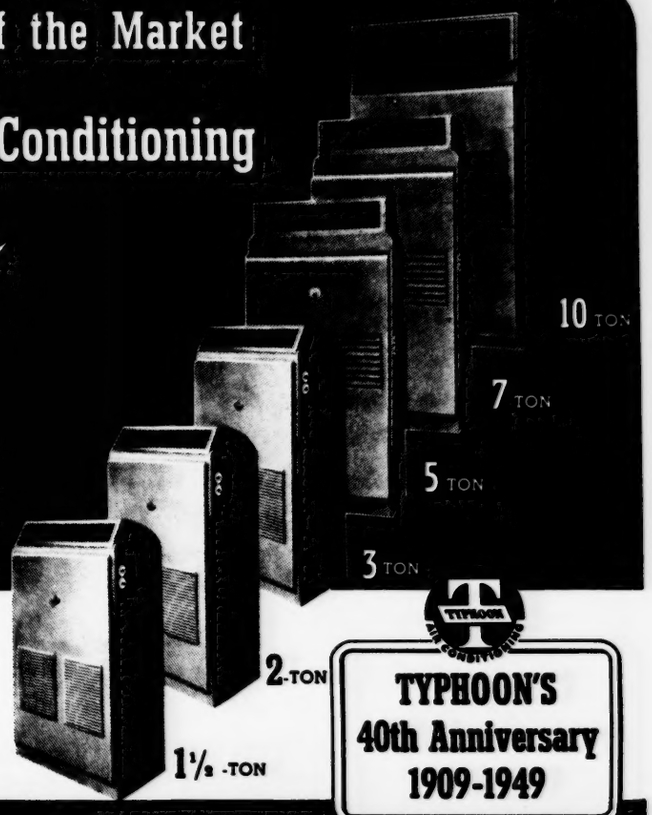
D. C. McCoy, refrigeration and frozen food authority of **Frigidaire Division of General Motors**, has been named editor-in-chief of the 1950 Refrigeration Applications Edition of the Refrigerating Data Book, published periodically by the ASRE.

Concentrate on the *Cream* of the Market

THE QUICK PROFIT RANGE in Air Conditioning

1½ Ton to *10 Ton*

PACKAGED UNITS



TYPHOON self-contained, free-standing units require no duct work..installation is quick, easy..you can do more jobs per year..your dollars turn over faster.

Plus a line of: EVAPORATIVE CONDENSERS — 3-5-7 and 10-ton sizes. COMPRESSORS — ½-ton to 50-ton units. LOW SIDE UNITS — 3-5-7-10-Ton.

Tie up with TYPHOON

Backed by a sales-winning program of dealer promotion and sales training. Nationally advertised.

TYPHOON'S 40th Anniversary 1909-1949

TYPHOON AIR CONDITIONING CO., INC.

794 UNION STREET · BROOKLYN 15, N. Y.

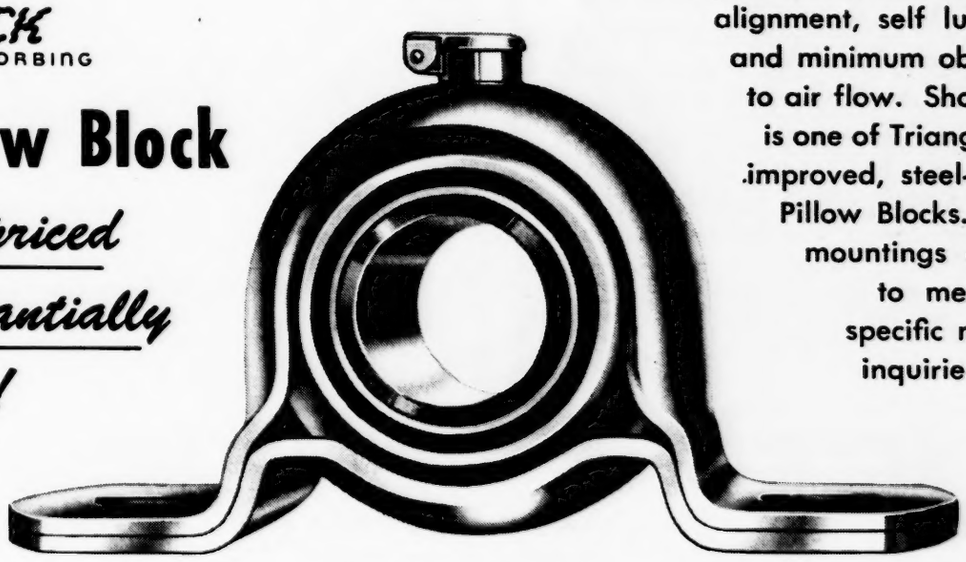
Improved New Design!

TRIANGLE

SHOCK-ABSORBING

Pillow Block

now priced substantially lower!



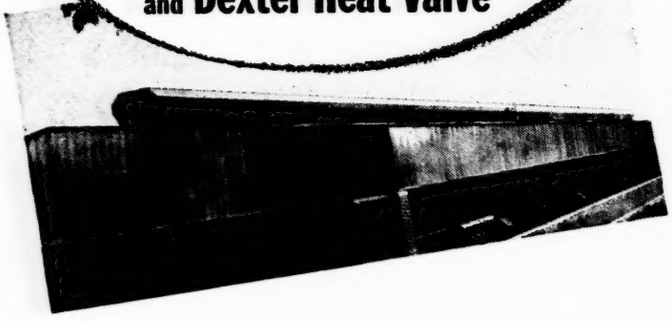
Designed for fans, blowers and other devices requiring silent operation, perfect alignment, self lubrication and minimum obstruction to air flow. Shown here is one of Triangle's new improved, steel-stamped Pillow Blocks. Special mountings designed to meet every specific need . . . inquiries invited.

WRITE DEPT. C FOR DETAILS

TRIANGLE MANUFACTURING COMPANY • OSHKOSH, WISCONSIN

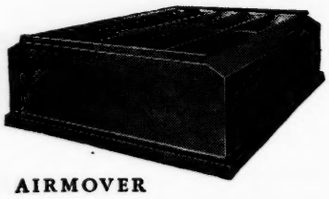
How to Show
Results
in factory ventilation

Swartwout helps you achieve outstanding natural ventilation with the
AIRMOVER
and Dexter Heat Valve

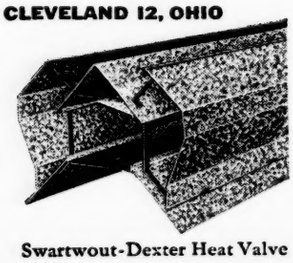


The important developments in roof ventilator design which have made Swartwout Equipment outstanding in this field mean efficient, economical ventilation for industrial buildings. The low, spreading AIRMOVER is ideal for large scale air movement—can be used to practically "open your roof to the sky"—while Swartwout-Dexter Heat Valve is "tops" for ridge, saw-tooth and skylight ventilation, widely used for over twenty years. It pays you to get Swartwout help on your ventilating problems. . . . Write for General Catalog.

The Swartwout Company
18568 EUCLID AVENUE • CLEVELAND 12, OHIO



AIRMOVER



Swartwout-Dexter Heat Valve

Swartwout
Controlled **Air Circulation**
EQUIPMENT FOR EFFECTIVE ECONOMICAL VENTILATION OF INDUSTRIAL BUILDINGS

T. S. House

Thornton S. House has been appointed sales manager, Warm Air Heating Division, **Richmond Radiator Co.** Mr. House has served as heating layout man, installer, jobber, salesman and sales manager. His background covers all types of coal, oil and gas equipment and installations. Prior to joining Richmond, House was sales manager for the Niagara Furnace Division of the Forest City Foundries Company of Cleveland, Ohio. With this company for ten years, he covered the entire Northeastern United States. Before that he was sales agent and jobber in the Syracuse area for the Fox Furnace Division of American Radiator Company. Mr. House also organized The House Sheet Metal Co. of Syracuse, N. Y., where he obtained his practical experience in heating layout and insta'lation work as well as in selling.

Henry E. Perry, president of Commercial Solvents Corp., was elected to the board of directors of **Carrier Corp.** at the annual meeting of stockholders. Mr. Perry also is president and director of the Commercial Molasses Corp. and vice president and director of the Thermatomic Carbon Co.

W. A. Matheson resigned his position as executive vice president of the **Eureka Williams Corp.** at a board meeting of the corporation held Friday, February 18, in New York City. The resignation was accepted. Mr. Matheson will continue as a director of the corporation.

Bruce L. Wilson has been appointed chief of the Engineering Mechanics Section of the National Bureau of Standards. In this capacity he will direct research on structural elements and metal structures. Mr. Wilson has been in charge of experimental research to determine fatigue strength of screw threads of various forms. Mr. Wilson was born in Graham, Washington, and received his bachelor's degree from Reed College (Oregon) in 1929. Immediately thereafter he joined the staff of the National Bureau of Standards, working in the Engineering Mechanics Laboratory.

The **Refrigeration Industry Safety Advisory Committee** has announced the appointment of **Cyrus W. Miller** as full-time secretary and safety code consultant, with offices at 155 E. 44th St., New York City. The Committee is sponsored jointly by representative groups of manufacturers of air conditioning and refrigeration equipment, including the Air Conditioning and Refrigerating Machinery Association, the Refrigeration Equipment Manufacturers Association, the National Electrical Manufacturers Association, and the Compressed Gas Manufacturers Association.

C. B. Lynde

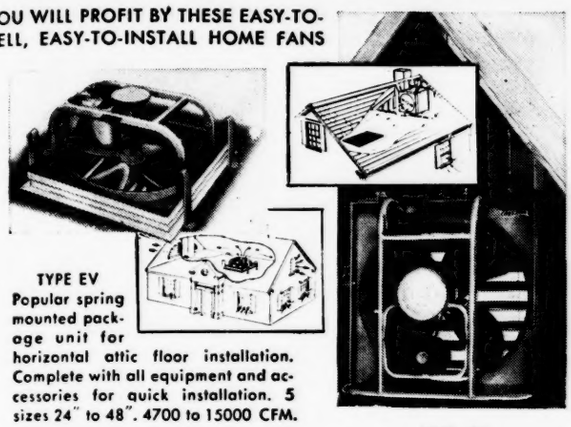
The Eagle-Picher Co. announces the appointment of **Clyde B. Lynde** as vice president and general manager of the Insulation Division of The Eagle-Picher Sales Co. A native of Union, Nebraska, Mr. Lynde began his business career in 1919 with the United Iron Works, Inc., and was headquartered at Dallas, Texas. In 1933 Mr. Lynde joined The Eagle-Picher Company as Joplin Insulation district manager and head of the insulation contracting department of that company. He served in both capacities for more than ten years, when he resigned to go into the insulation contracting business for himself in an organization known as Industrial Insulators, Inc., distributing and applying Eagle-Picher insulations in the Houston, Texas, area. Mr. Lynde was active during the war in the construction of several of the largest high-octane gasoline refineries, synthetic rubber plants, and chemical process plants in the Southwest.

Year 'round COMFORT

Provide summer cooling with

CHELSEA COMFORT COOLERS

YOU WILL PROFIT BY THESE EASY-TO-SELL, EASY-TO-INSTALL HOME FANS



TYPE EV
Popular spring mounted package unit for horizontal attic floor installation. Complete with all equipment and accessories for quick installation. 5 sizes 24" to 48". 4700 to 15000 CFM.

TYPE EH
Brand new spring mounted package unit for vertical attic installation. Easy to install with minimum building alteration. 9 models from 24" to 60". 5000 to 25000 CFM.

ALSO 4 *NEW* WINDOW FAN MODELS FOR QUICK "OVER-THE-COUNTER" SALES!

Sizes from 12" to 30"—single and variable speeds. Ideal for installation where permanent Comfort Coolers are less adaptable. 1000 to 8200 CFM.

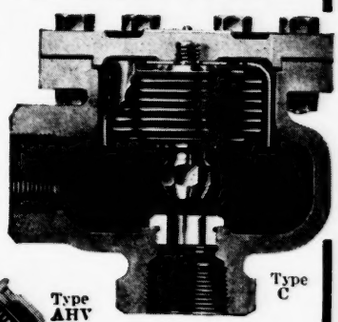
WRITE FOR CATALOG 863 describing Window Fans and the complete line of Comfort Coolers from 24" to 60"

CHELSEA FAN & BLOWER CO.
INCORPORATED
1206 GROVE STREET, IRVINGTON 11, NEW JERSEY

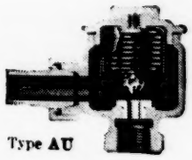
Nicholson Steam Traps Show

PRODUCTION INCREASES UP TO 30%

2 to 6 Times More Drainage Capacity Speeds Circulation



Type C



Type AU

Type AHV

Bulletin 1047 or see Sweet's

Plant records show that the unequalled drainage capacity of Nicholson thermostatic steam traps increases production up to 30%. Other reasons why an increasing number of leading plants are standardizing on Nicholson: operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure; record low for steam waste (as low as 1%). 5 types for every purpose: size ¼" to 2"; pressure to 225 lbs.

W. H. NICHOLSON & CO. 199 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

FOR

Quality Products Prompt Service Profitable Cooperation

Buy from a Herman Nelson Distributor like Tay-Holbrook, Inc., of California

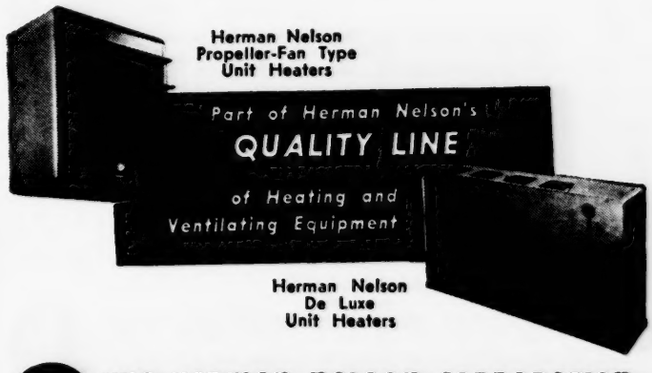
J. Milton Hagler, President,
Tay-Holbrook, Inc.
Headquarters at San Francisco
with Branches at Oakland, Sacramento,
Fresno, San Jose, Stockton, Berkeley, Santa Rosa

Tay-Holbrook, Inc., recognized as a leader on the Pacific Coast, is another of Herman Nelson's carefully selected Distributors. Dealers everywhere appreciate more and more that it's profitable for them to install top quality Herman Nelson Heating and Ventilating Products and receive friendly, intelligent cooperation from Herman Nelson Distributors like Tay-Holbrook, Inc.

The Herman Nelson nameplate means unmatched excellence of product. Herman Nelson engineers, with 43 years' experience, have developed mastery of workmanship and design . . . resulting in products that provide superior results in actual service all over America.

Of primary importance to every dealer is delivery. Herman Nelson Distributors maintain stocks of both products and materials required for installation, insuring prompt service. Carefully prepared Herman Nelson advertising, sales promotion material and comprehensive engineering data will bring added profits to you as a dealer.

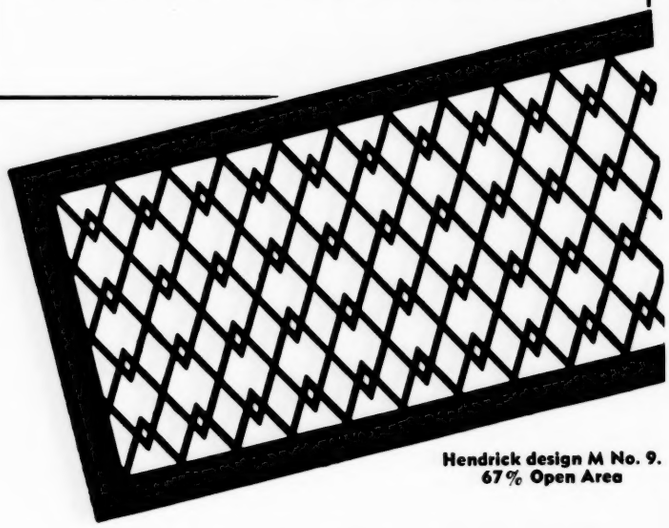
Yes, quality products, prompt service and intelligent cooperation have built an enviable reputation for Herman Nelson Dealers everywhere. They will do the same for you. Get the details from your nearest Herman Nelson Distributor today.



THE HERMAN NELSON CORPORATION
Since 1906 Manufacturers of Quality Heating and Ventilating Products
MOLINE, ILLINOIS

Decorative Grilles

suitable for Bulator Installations



Hendrick design M No. 9.
67% Open Area

For use with the new Hendrick BULATOR* – the first practicable combination of a deflecting vane grille with an ornamental grille – there is a wide choice of Hendrick Ornamental Metal Grilles that have the proper open area.

The ornamental grille does not appreciably affect the desired air throw and spread, and the deflecting vane grille is not noticeable although mounted directly behind the ornamental grille.

The vanes of the deflecting grille are adjustable, so that the air flow can be deflected to right or left, up or down, or in a combination of directions.

The BULATOR enables the architect to combine with the air-conditioning system of a building, a design of ornamental grille which harmonizes with the decorative scheme he has chosen.

Write for Bulator folder and detailed information on the many Hendrick ornamental grille designs that have the essential open area for Bulator installations.

***BEAUTY + VENTILATOR**

SEE OUR CATALOG IN SWEET'S

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

HENDRICK
Manufacturing Company
42 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

E. A. Cline of The Trane Co., La Crosse, Wis., was elected president of the **Convector Manufacturers Association** at the group's annual meeting in the La Salle Hotel, Chicago. **Louis D. Mandell,** of C. A. Dunham Co., Chicago, was named vice president, and **J. H. Smart,** Tuttle & Bailey, Inc., New Britain, Conn., was elected secretary.

E. J. McFadden

Combustion Engineering-Superheater, Inc., New York, announces the appointment of **E. J. McFadden** as general sales manager of its water heater, range boiler and soil pipe department. Since his graduation from Ohio Wesleyan in 1934, Mr. McFadden's experience has included Government service (U. S. Department of Commerce), advertising agency work, editorial work on a trade publication, and advertising and sales promotion for General Electric Company. He entered the armed services in 1942 and was commissioned a captain in anti-aircraft artillery, serving 28 months in the European theatre. Following his discharge in November, 1945, he returned to General Electric and was made sales manager of the water heater division. Mr. McFadden will make his headquarters at the Company's plant in Chattanooga, Tennessee.

Appointment of **Robert H. Jacobs** as superintendent of schoolhouse control sales for the **Minneapolis-Honeywell Regulator Co.** has been announced. The appointment establishes a new position in the company. Mr. Jacobs is a graduate of Marquette University. He was employed in the sales departments of the Parker Pen Co. and Standard Oil of Indiana before joining Honeywell in 1940. After training, he was assigned to the commercial division's sales department of the Milwaukee branch office. In his new position, Mr. Jacobs will continue to make his headquarters in the Milwaukee office.

The appointment of **J. W. LeRoy** as assistant to Carroll M. Baumgardner, vice president for sales, has been announced by **The National Radiator Co.,** Johnstown, Pa. For some years Mr. LeRoy has been associated with the Berger Mfg. Div. of Republic Steel Corp., Canton, O., as manager of special products' sales.

Frank H. Stohr has been named general manager of the **Allis-Chalmers Manufacturing Co.'s** Norwood Works. Mr. Stohr, before taking over his new duties, was executive vice president and a director of the Elliott Co. of Jeannette, Pa. He succeeds R. W. Davis, general manager of the plant since 1944. Mr. Davis, who has been a member of the Allis-Chalmers organization for 40 years, will continue in an advisory capacity to the general manager.

INDUSTRIAL DEGREE-DAYS

January, 1949

City	55F Base	45F Base
Baltimore, Md.	392	131
Buffalo, N. Y.	735	427
Chicago, Ill.	770	462
Cleveland, Ohio	624	324
Detroit, Mich.	725	416
Indianapolis, Ind.	648	344
New York, N. Y.	497	207
Philadelphia, Pa.	450	166
Pittsburgh, Pa.	465	202
St. Louis, Mo.	657	372

RADIANT FLOOR PANEL HEATING *plus* FILTERED CIRCULATING WARM-AIR

Both in one unit - At less than the cost of conventional heating!

The INTERNATIONAL
WARM-AIR AUTOMATIC
OIL or GAS FURNACE

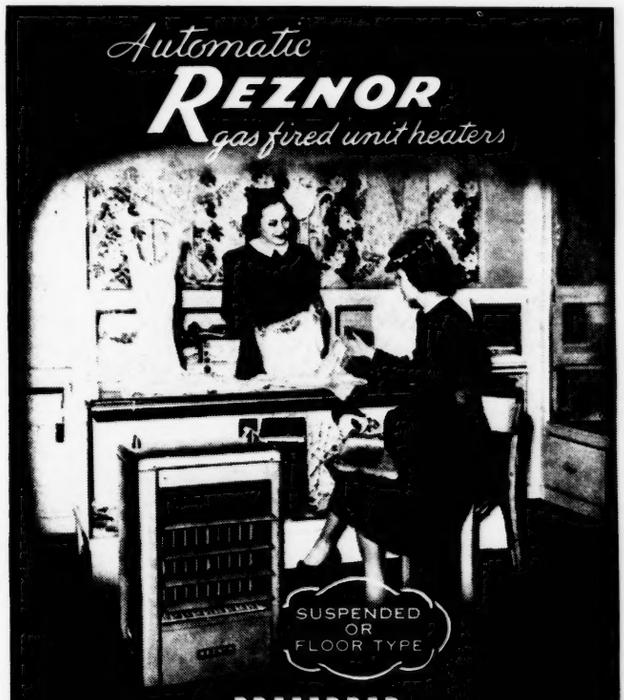
FOR RANCH-TYPE or BASEMENTLESS HOMES...

A truly great advance in modern heating engineering — that really overcomes the basic problems of home heating. Under-floor ducts eliminate cold floors and chilly walls . . . Base register banishes cold air cascading down windows . . . Elimination of air stratification assures uniform temperatures at all levels. Low cost installation — economical operation.

Send for literature giving details and typical layouts.

INTERNATIONAL
OIL BURNER CO.
3810 Park Avenue St. Louis 10, Mo.

Automatic
REZNOR
gas fired unit heaters



PREFERRED

• Clean heat • Customer-employee comfort • For homes, offices, stores, factories • Leads world in sales since 1888 • Catalog U-45 shows many exclusive features • Dealers everywhere — WRITE TODAY.

REZNOR MANUFACTURING CO.
9 UNION ST. • MERCER, PENNA.

Introducing...

JOE RAMSETTER!

If you don't know JOE RAMSETTER, you're missing a profit-maker. Joe carries the sharpest pencil you ever saw, for cutting costs and saving time on fastening jobs in steel, concrete, brick, other hard materials. It's the RAMSET FASTENING SYSTEM.

No chipping! No drilling! No plugging! Not for Joe! In 30 seconds, he prepares the tool, then places it against the work, taps it—and RAM! It instantly sets pins and threaded studs up to 6" long and 5/8" diameter. It's fast, it's tight, it's as economical as reading a newspaper over a neighbor's shoulder.

Five pounds of RAMSET TOOL do the trick. Self-contained, and completely portable. Easy to use. In 30 minutes, we teach any good, careful workman to RAMSET up to 50 fastenings per hour.

RAMSET SYSTEM saves so much time and money you won't believe it until you see it. Better send for Joe to demonstrate on your own jobs. Just mail the coupon. *Stemco Corporation, Cleveland 16 (Rocky River), Ohio.*

Ramset
FASTENING SYSTEM

MAIL THIS COUPON

Stemco Corporation,
Cleveland 16 (Rocky River), Ohio
Please have JOE RAMSETTER show us how to save time and costs on fastening jobs.

HV-3

Name _____

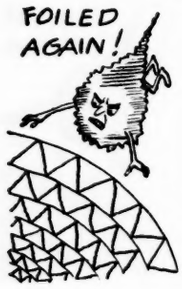
Company _____

Address _____

As advertised in TIME and NEWSWEEK

AIR-MAZING FACTS

1. BREATHING HEAVILY! The air you breathe in a week's time weighs more than you do!



2. WHAT'S YOUR TYPE? Hundreds of types of filters to remove dirt from the air and contamination from liquids have been developed by Air-Maze, the filter engineers.

3. AIR-MINDED HOTELS! To give you the utmost in comfort, thousands of leading hotels, restaurants, trains and office buildings keep their air clean and pure with Air-Maze filters—first choice of ventilating engineers and architects.

WHETHER YOU build or use engines, compressors, air conditioning and ventilating equipment, *or any device using air or liquids* —the chances are there is an Air-Maze *engineered* filter to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

AIR-MAZE

The Filter Engineers

AIR FILTERS
SILENCERS
SPARK ARRESTERS
LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

Canadian Degree-Days for January, 1949*

City	January 1949	January Normal	Cumulative, Sept. 1 to Jan. 31 1948-49	Cumulative, Sept. 1 to Jan. 31 Normal
Calgary, Alta.	1755	1609	5465	5311
Charlottetown, P.E.I.	1321	1463	3966	4328
Crescent Valley, B. C.	1686	1352	5105	4631
Edmonton, Alta.	1913	1814	6000	5798
Fort William, Ont.	1705	1807	5193	5622
Grande Prairie, Alta.	1931	1841	6411	6000
Halifax, N. S.	1152	1283	3473	3898
London, Ont.	1141	1336	3647	4013
Medicine Hat, Alta.	1894	1643	5341	5032
Moncton, N. B.	1370	1528	4260	4714
Montreal, P. Q.	1363	1552	3936	4648
North Bay, Ont.	1593	1658	4726	5161
Ottawa, Ont.	1472	1646	4171	4923
Penticton, B. C.	1519	1184	4441	3810
Porquis Junction, Ont.	1869	2052	5321	6300
Prince George, B. C.	1804	1615	5857	5372
Quebec City, P. Q.	1460	1696	4265	5207
Regina, Sask.	2161	2037	6293	6373
Saskatoon, Sask.	2154	2027	6339	6276
St. John, N. B.	1271	1417	3856	4386
Toronto, Ont.	1099	1304	3303	3948
Vancouver, B. C.	1104	893	3545	3061
Victoria, B. C.	976	815	3109	2725
Windsor, Ont.	1038	1283	3246	3729
Winnipeg, Man.	2074	2111	5768	6316

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

The Department reports a slight revision in the figures for December as published in last month's issue. Corrected figures are: Charlottetown, P.E.I., 1138; Montreal, P. Q., 1194.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

WARM AIR CONFERENCE—18th annual Forced Warm Air Conference, sponsored by Michigan State College, at the MIT college campus, East Lansing, Mich. John C. Leonard, assistant news editor, public relations department, Michigan State College. ..... **MARCH 21-24, 1949.**

AIR CONDITIONING CONFERENCE—5th annual Air Conditioning Conference, sponsored by Mechanical Engineering Department of Texas A & M College, at College Station, Texas. Prof. Lester S. O'Bannon, Texas A & M...**MARCH 28-30, 1949.**

HYGIENE CONFERENCE—Joint conference of four groups, including American Industrial Hygiene Association, at the Hotel Statler, Detroit, Mich. Dr. Henry Smythe, Jr. Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13, Pennsylvania. .....**APRIL 2-10, 1949.**

LUBRICATION CONVENTION AND SHOW—4th annual convention and 2nd all-lubrication exhibit of the American Society of Lubrication Engineers, at the Hotel Statler, New York, N. Y. ..... **APRIL 11-13, 1949.**

CORROSION CONFERENCE AND SHOW—Annual conference and exhibition of the National Association of Corrosion Engineers, at Netherland-Plaza Hotel, Cincinnati, Ohio. Secretary of Association, Houston 2, Tex. .....**APRIL 11-14, 1949.**

POWER CONFERENCE — 1949 Midwest Power Conference, sponsored by Illinois Institute of Technology, and including sessions on heating and air conditioning, and on the heat pump (9:00 a.m. and 10:30 a.m., respectively, on April 20) at Hotel Sherman, Chicago. Conference director, Roland A. Budenholzer, Illinois Institute of Technology, 3300 South Federal St., Chicago 16, Illinois. .....**APRIL 18-20, 1949.**

PROFESSIONAL ENGINEERS CONVENTION—22nd annual convention, The New York Society of Professional Engineers, Inc., at Hotel New Yorker, New York. E. J. Quirin, vice president, Frederic R. Harris, Inc., 27 William Street, New York 5, N. Y. .....**APRIL 21-23, 1949.**

(Continued on page 130)

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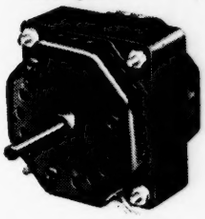

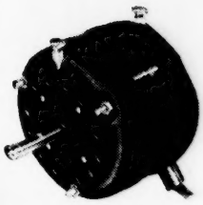

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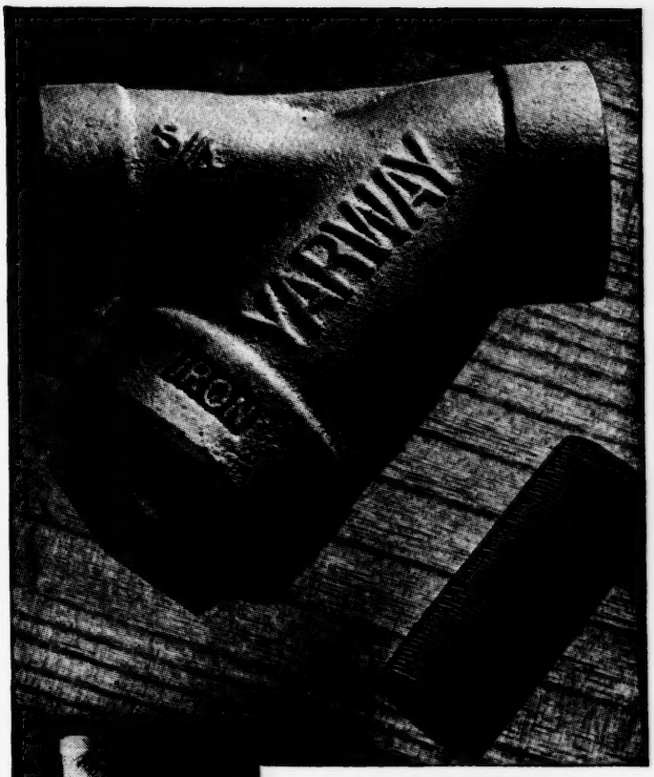

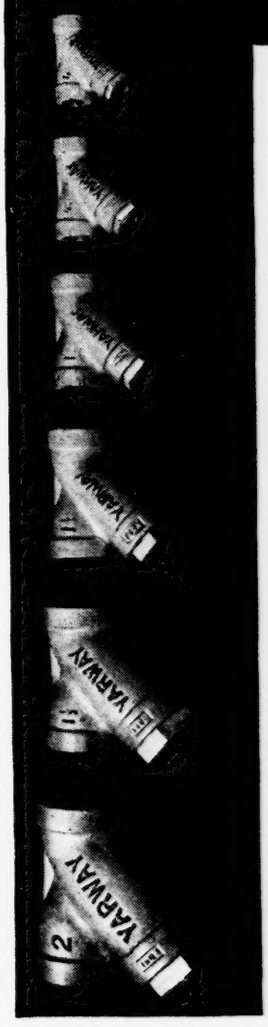

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